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NATURE

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*" To the solid ground
Of Nature trusts the mind which builds for aye "*—WORDSWORTH

SATURDAY, JANUARY 5, 1929

CONTENTS

Cancer

A GOOD deal has been done in recent years to elucidate the laws of animal growth—the rules, that is, which determine that each individual animal grows, develops, and differentiates until its body has reached a certain size, with its various parts and organs in certain proportions and in certain relationships to one another The deadly precision with which the ' normal ' result is achieved is so commonplace that we wonder at it less than we do at the much rarer cases when the regulatory mechanism goes wrong That is the naturalist's instinct ' Treasure your exceptions ' is, within reasonable bounds, a sound rule, and the study of unnatural forms of growth is as likely a road as any other to lead us to an understanding of normal development Of all the varieties of abnormal growth, we know most about tumours, especially of human tumours, and more particularly of those which by their nature tend to kill the individual in which they grow and which we distinguish as ' malignant tumours ' or ' cancer '

The natural history of man is known far better than that of any other animal an industrious worker may examine a hundred thousand individuals of some wild species ; most people would think they had done pretty well if they had closely scrutinised five hundred But the organised activities of public health authorities now keep under pretty close observation some 200 million people, and tell us, with tolerable if improvable accuracy, the reasons why they die from year to year and from childhood to old age We know from these data that cancer is one of the chief causes of death in civilised countries in temperate climates, and we have a great mass of information about the sex,

age, occupation, and other circumstances of the people who die from it

The whole 'cancer problem' is therefore of considerable interest from many points of view—biological, medical, and personal—and these are all represented in the report[1] lately published, of the International Conference on Cancer, held in London last July under the auspices of the British Empire Cancer Campaign The twenty sixth annual report of the Imperial Cancer Research Fund also contributes once again its record of the steady, sober progress which that organisation has so consistently maintained first under Dr E F Bashford and in recent years under Dr J A Murray Where does the problem now stand ?

A cancer grows from and is composed of cells of the body in which it arises It differs from normal tissue in its gross morphology in its minute structure, and in its functional relationships but these differences are quantitative rather than qualitative Anatomically and physiologically the degrees of resemblance and difference vary widely in different instances some tumours are very like normal tissue, some are bizarrely different All attempts to define any specifically malignant character have failed Mr H G Crabtree has lately shown that Warburg's criterion of a capacity for anaerobic glycolysis is not valid since cellular overgrowths of an inflammatory nature show the same sort of metabolism The most definite feature of cancers is their relative detachment and isolation in the co operative community which is formed by the tissues and organs of the body The normal anatomical relationships of epithelium and connective tissue for example are due to the mutual restraint of each tissue on the other if a cancer starts in the epithelium, it is not held in check by the connective tissue it defies the laws of normal growth and produces tissue which does not subserve the proper functions of epithelium towards the underlying tissues and the rest of the body

Similarly, cancer cells are not subject to the ordinary rules of senescence Growing old and eventually so old that life ceases, is a function of the body as a whole, not of individual tissues If a normal embryonic tissue is isolated from the rest of the body in artificial culture, it can be propagated by periodical transplantations for a time much longer than the natural life of the animal species from which it came, and probably indefinitely A mouse cancer is physiologically isolated in an analogous manner it never grows old, and by transplantation from mouse to mouse can be kept alive for many natural generations of mice, and probably for ever

Pieces of tissue which are in this way detached from the communal activities of the body as a whole are as might be anticipated, useless The fat in a fatty tumour is not available as a source of energy for the body a tumour of stomach epithelium does not secrete gastric juice, nor is a muscular tumour of the uterus of any value in retaining or expelling a fœtus But which could scarcely have been predicted they are also harmful, it is after all the great practical quality of cancers that they kill In many cases they do this by interfering in a gross way with the normal working of the stomach or intestines or brain or lungs But they kill with equal certainty if they do not involve any vital organ and questionless they produce some substance which is poisonous to the rest of the body often shown most strikingly by the production of an extreme degree of wasting Few attempts have been made to explain this general ill effect and we really know nothing of its intimate mechanism Why cancer kills is a very interesting question which still needs an answer It may be that there is a biological principle that cells which are not with the body are against it

Far more attention has naturally been given to the origin and causes of the dissociated growth All the evidence goes to show that it is due to a reaction between the tissues and some external stimulation Organisms exist only in relation to their environment normal organisms react to a normal environment in such a way that each is in perfect adaptation with the other In cancer there is something wrong with both

There is no substantial evidence that cancer is due to any sort of parasite Malignant tumours produce substances which can stimulate normal cells to take on a cancerous way of growth, in some ways they resemble the invisible viruses which are the causes of some infectious diseases, but these carcinogenic agents have never been found apart from tumours and it seems most likely that they arise in and are the result of cancer rather than its cause The cumulative indications, however that cancer is caused by various forms of stimulation which we may group together as chronic irritation, become more and more impressive, and fresh examples of the association are continually being brought forward Irritation involves cell injury and cell destruction, and any class of agents which can injure cells may evoke cancer as a response—mechanical, thermal, chemical, parasitic and radiant injury are all effective But

[1] John Wright and Sons, Bristol. 1928. Pp 588.

though a jagged tooth, swallowing food too hot, working in arsenic, being infected with the worm *Schistosomum*, and X rays may all cause cancer, experiments on animals and observations on man agree in attaching special efficacy to soot, tar, shale oils, and other products of destructive distillation

There are strong grounds for thinking that this is the environmental factor which connects a high cancer incidence with civilisation and town life Man is an artificial animal, and he is evidently far from perfectly adapted to the surroundings which he makes for himself Human and animal experience also agree in showing that cancer follows injury only after a long latent period, during which the irritation may or may not be continued The interval in mice is of the order of one third of their natural span of life a corresponding period of 15 to 20 years is suggested by the human data If man lived, like a wild animal, only for the years of his physical perfection and generally finished about 30 or 35, few people would have malignant tumours They are not common until ages of forty and upwards are reached—a prime fact in their epidemiology which is consistent with the view that irritants are the most important stimuli of cancerous growth, especially when this mode of response is given better chances to emerge by man's unnatural habit of keeping himself alive a good deal longer than was intended

Whether irritants produce cancer or not depends also on the tissues which are involved Recent observations show in a variety of ways that the constitution of the irritated individual is far from immaterial Experimentally it is easy enough to make malignant tumours with tar in mice, difficult or next to impossible in rabbits, rats, or guinea-pigs Within the same species, races and individuals differ in the same way Mice are so prone to develop 'spontaneous' cancers that the incidence of the disease may be observed in them as it may be in man Some strains are more cancerous than others, and the original demonstration by the Imperial Cancer Research Fund, that a tendency to have cancer could be exaggerated by selective breeding, has been very fully confirmed by the massive observations of Miss Slye, Prof Leo Loeb, and others Races have been obtained in which nearly every mouse dies of cancer, other races in which cancer is almost unknown, and it is quite clear that the liability to respond to irritation by producing a cancer is a heritable constitutional quality, depending apparently on more than one Mendelian factor, and difficult to trace through man's promiscuous breeding

We have also learned in recent years that these constitutional differences may be acquired as well as in born If a large number of mice are tarred to the same extent, the time at which they will develop tumours in response will vary widely some individuals are much more refractory than others If the cancers of the skin which first appear in the most susceptible animals are removed by operation, it proves to be exceedingly difficult or impossible to produce a second tar tumour in the same animal Mice from which spontaneous tumours have been excised are equally refractory The development of one cancer thus produces some alteration in the whole economy of the animal, which makes it everywhere less responsive to carcinogenic irritation

These experimental facts are reflected in human experience Multiple malignant tumours in one person are less common than they should be if the development of one had no relation to the development of others cancers of the breast and of the uterus are so common that examples of the occurrence of both in the same woman should be fairly frequent instead of rare The analysis of international statistics, in which a committee of the League of Nations has taken an important part, also suggests that relative freedom from cancer of one organ may be made up by relative abundance in another organ Thus in England, Holland, Switzerland, and Japan the death rate from cancer is about the same in each case the absence of cancer of the breast and uterus in males is counterbalanced by a higher rate for cancer of the alimentary canal, so that the total incidence in the two sexes is the same In Japan, cancer of the breast is relatively unimportant, but cancer of the uterus is so much commoner that the mortality from both is higher than in Holland or Switzerland Through several lines of approach, therefore, we reach the conclusion that there is a cancerous diathesis affecting the body as a whole as well as a heritable liability for some particular organ to be involved

The progress in our knowledge of cancer, its nature, causes, and cure, cannot from any point of view be regarded as unsatisfactory The mystical ideas of thirty years ago have been replaced by a clear biological conception of stimulus and response It cannot be long before we shall be able to define more closely the essential characters of effective stimuli on one hand and on the other the constitutional qualities which lead a tissue to give a cancerous response The 'cancer problem' is far from solved, but it seems much more soluble as time goes on

Eddington on the Nature of the World

The Nature of the Physical World By Prof A S Eddington (Gifford Lectures, 1927) Pp xix + 361 (Cambridge At the University Press, 1928) 12*s* 6*d* net

THE lectures endowed by Lord Gifford in 1887 for "promoting and diffusing the study of Natural Theology, in the widest sense of the term—in other words, the knowledge of God"—were delivered in 1927 in Edinburgh by Prof Eddington At the time they excited an interest which, even after allowing for the traditional intellectual fervour of the Scottish capital, must be regarded as altogether exceptional and now that they are published, the interest is likely to become universal

"I propose," Prof Eddington says in the Introduction, "to discuss some of the results of modern study of the physical world which give most food for philosophic thought This will include new conceptions in science and also new knowledge In both respects we are led to think of the material universe in a way very different from that prevailing at the end of the last century" In the last four chapters he considers the position which the new scientific view should occupy in relation to religion

Descriptions of the phenomena of atomic physics as given in popular text books have an extraordinary vividness We see nuclei surrounded by circulating electrons, which from time to time are tossed into higher orbits by X rays or torn away altogether, and after hairbreadth escapes are again caught and fall back again The success of this model in co ordinating the facts of spectroscopy shows that it bears some analogy to the actual atom, but (as is made clear by wave mechanics) there is no real resemblance The fall of an electron from one orbit to another is merely a conventional way of representing a particular change of state of the atom which cannot properly be represented by movements in space as macroscopically conceived *Something unknown is doing we do not know what*—that is what the theory amounts to The reason why it is fruitful is that our descriptions are not limited to unknown agents executing unknown activities, but include *numbers* scattered freely in the description To contemplate electrons circulating in the atom carries us no further, but by contemplating eight circulating electrons in one atom and seven circulating electrons in another, we begin to realise the difference between oxygen and nitrogen Out of the numbers proceeds that harmony of natural law which it is the aim of science to disclose

So far, Eddington is just a Pythagorean "The leading principle of Pythagoreanism," as Walter Pater said, "was the universality, the ultimate truth, of numerical law, analogous to the numerical laws of harmony in music the finite (τὸ πέρας) or definable, with all the unity in variety of concerted music, ever controlling the infinite (τὸ ἄπειρον), the indefinite, formless brute matter of our experience of the world," and the plan of the whole book reminds us forcibly of what Proclus says of Pythagoras, that he "examined the principles of natural knowledge to the bottom, and investigated its theories in an immaterial and intellectual manner" (αὔλως καὶ νοερῶς) Let us see, then, how Eddington illustrates his view about the nature of exact science by analysing, in an immaterial and intellectual manner, an examination question

"If we search the examination papers in physics and natural philosophy for the more intelligible questions, we may come across one beginning something like this 'An elephant slides down a grassy hillside ' The experienced candidate knows that he need not pay much attention to this it is only put in to give an impression of realism He reads on 'The mass of the elephant is two tons' Now we are getting to business the elephant fades out of the problem and a mass of two tons takes its place What exactly is this two tons, the real subject matter of the problem? It refers to some property or condition which we vaguely describe as 'ponderosity' occurring in a particular region of the external world But we shall not get much further that way the nature of the external world is inscrutable, and we shall only plunge into a quagmire of indescribables Never mind what two tons *refers* to what *is* it? How has it actually entered in so definite a way into our experience? Two tons *is* the reading of the pointer when the elephant was placed on a weighing machine"

Similarly for the other data of the problem Thus by the time the serious application of exact science begins, we are left only with pointer readings *Science is simply the linkage of pointer readings with pointer readings*

The Victorian physicist felt that he knew just what he was talking about when he used such items as *matter* and *atoms* Atoms were tiny billiard balls, a crisp statement that was supposed to tell you all about their nature in a way that could never be achieved for transcendental things like consciousness, beauty, or humour But now we realise that science has nothing to say as to the intrinsic nature

of the atom The physical atom is, like everything else in physics, a schedule of pointer readings The schedule is, we agree, attached to some unknown background, but what it is we do not know Only in one case—namely, the pointer readings of our own brains—have we an insight that is not limited to the pointer readings and that insight shows that they are attached to a background of consciousness'

Why not, then, suppose that the unknown back ground of all pointer readings is something con tinuous with our mental nature, something of the nature of consciousness? Why should not the stuff of the world be mind stuff? What knowledge have we of the nature of atoms that renders it all incongruous that the assemblage of atoms constituting a brain should be of itself a thinking object?

The doctrine that ultimate reality is of the nature of mind, or thought content, is as old as Plato, but Eddington's approach to it is original and bears not much resemblance to that of the idealist meta physicians His lectures, coming from a physicist of the front rank, will penetrate where philosophers have never found a hearing and how much need there is for teaching such as Eddington's may be realised when we compare him with (for example) Bishop Barnes, who, in his objections to the Catho lic doctrine of the Sacraments, still seems to be dominated by the nineteenth century physicist's conception of matter as something necessarily and entirely unspiritual

Having swept away one of the two principal causes of tension between science and religion—namely, the association of science with materialistic philosophy—Eddington now turns to the other, namely, the deterministic character which has hither to been attributed to physics, and the difficulty of reconciling scientific determinism with doctrines of human free will and responsibility Here the solu tion is one that could not have been dreamt of twenty years ago—it is nothing more or less than a total denial of determinism in physics itself 'On the scientific side," he says, "a new situation has arisen It is a consequence of the advent of the quantum theory that *physics is no longer pledged to a scheme of deterministic law* Determinism has dropped out altogether in the latest formulations of theoretical physics and it is at least open to doubt whether it will ever be brought back. The future is a combination of the causal influences of the past, together with unpredictable elements—unpredictable not merely because it is impractic-able to obtain the data of prediction, but because no data connected causally with our experience exist"

The position is that the laws governing the microscopic elements of the physical world—individual atoms, electrons, quanta—do not make definite predictions as to what the individual will do next These laws indicate several possibilities in the future and state the odds on each In general the odds are moderately balanced and are not tempting to an aspiring prophet But short odds on the behaviour of individuals combine into very long odds on statistics of a large number of individuals, and all the successful predictions hitherto attributed to causality are traceable to this

The questions which have been referred to in this review are only a small proportion of those dealt with in what must be regarded as an epoch-making book Considerable discussion may be expected for example, over the doctrine propounded in Chapter xi, that Einstein's gravitational field-equations and Maxwell's electromagnetic field-equations are not controlling laws of physics, but mere truisms, the violation of which is unthinkable, like the law that $3+1=2+2$ I must confess my self unable to follow the argument here, especially as Eddington indicates (p 237) that in his opinion the law of ponderomotive force of the electric field is *not* to be regarded as one of these truisms for it is known (as is proved, *e g*, in *Proc Roy Soc*, **118**, pp 509 511, 1927) that the equations of pondero motive force are merely mathematical consequences of Einstein's gravitational field equations and Max-well's electromagnetic equations

In conclusion, we may express our satisfaction that Eddington has avoided two pits into which many other travellers in these regions have fallen The first is indicated in his own words

' A besetting temptation of the scientific apolo-gist for religion is to take some of its current ex pressions, and after clearing away crudities of thought (which must necessarily be associated with any-thing adapted to the everyday needs of humanity) to water down the meaning until little is left that could possibly be in opposition to science, or to anything else"

If the Christian religion had meant no more than some of its modern expositions, need the early Christians have suffered martyrdom?

And the other, also in his own words

"The religious reader may well be content that I have not offered him a God revealed by the quantum theory, and therefore liable to be swept away in the next scientific revolution"

E T WHITTAKER.

Science and Life

Point Counter Point By Aldous Huxley Pp v + 601 (London Chatto and Windus, 1928) 10*s* 6*d* net

SCIENCE, by flinging into the lap of an unprepared world an over rich and embarrassing assortment of food for thought, must be held responsible for the mental indigestion from which the world is suffering It is not surprising, considering the bewildering array of new knowledge and the number of new theories spread before us, that the only beliefs are unbeliefs, that traditions are anachronisms, and precedents ephemeral things This is not an age of reason but of unreason We are attempting to explain everything in terms of psycho physiologico physico concepts, but have so far succeeded only in making life more complicated for the majority No great synthesis of our new knowledge has yet been attempted upon which to base a guiding philosophy for puzzled mankind Mr H G Wells may yet accomplish this task for us, but that it has still to be done is the opinion held by many, an opinion which will find reinforcement in this latest volume by Mr Aldous Huxley, in which nearly every character is shown either floundering or detached

"Point Counter Point" will not satisfy those who want novels based on the Richardson model, "a story wrought round the passion of love to a tragic or joyous conclusion," or that of Scott, who combined excellence of characterisation with the harmonious development of his plots Mr Huxley flouts such conventions He conveys the impression that the principal character of the book is outside it Interestingly and provokingly drawn as they are, we have not to read far to become less interested in his characters than in himself, less interested in their outlook on life than speculative about his He introduces character after character into his pages, psycho analyses them, and then lays them aside once they have served the purpose either of explaining their reactions to environmental stimuli in terms of old or new theories of behaviourism, or as vehicles for the expression of his varied and conflicting thoughts on different types His analyses are brutally realistic, although it is probable that, by restricting his field of choice to exaggerated types obsessed by sex, he loses some of his effect At the end he leaves us wondering whether he intends to point a moral or merely to record his observations concerning the disastrous effects on some people of the breakdown of tribal authority and the waning influence of taboos resulting from the impact of science on society But he makes it clear that he despises most of the devices by which most writers maintain interest in their characters, while at the same time showing more than once that he could, if he would, write a thrilling 'best seller' conforming to pattern

However, we need not be concerned here with Mr Huxley's merits or demerits as a novelist They have been dealt with elsewhere by others whose business it is to tell the members of the general public what they should think about the books written for them What should interest us is his attitude towards science and scientific workers, and his assumption that the creative scientific research worker is something essentially different and less human than the creative artist It is for his explanations of, and his onslaughts on, science, rather than for his studies in psycho pathology, that this volume should be read by all who consider themselves specialists in any branch of science Having been for years held up to the wonder and admiration of the world by Mr H G Wells, scientific workers may need the corrective to their self-esteem which Mr Huxley supplies Rampion, his artist, remarks

> "The lizards died of having too much body and too little head, so at least the scientists are never tired of telling us Physical size is a handicap after a certain point But what about mental size? These fools seem to forget that they're just as top heavy and clumsy and disproportioned as any diplodocus Sacrificing physical and effective life to mental life What do they imagine's going to happen? They're just marching towards extinction, they're marching the rest of the world along with them"

Rampion and his wife, incidentally, are the only really attractive characters Mr Huxley introduces into his six hundred pages, though it must be confessed that Rampion's fulminations against physical research—the search for "non human truth" as he calls it—becomes somewhat tiresome, partly through repetition, but mostly because all the explanation given of the other kind of truth, 'human truth," is that it is something you discover by living—"living completely, with the whole man"—to which any interpretation can be given

Apparently the assumption is made that persons like scientific specialists, absorbed in an intellectual occupation for a great deal of their time, are necessarily consistently 'mental, conscious, and voluntary," and never "physical, intuitive, instinctive, and emotional," in their reactions The fact is that most modern scientific specialists are ruled by their prejudices and emotions in everything except

their own small branches of study They are neither rational nor realistic in most affairs of life, merely normal, which is a real misfortune to the world and the civilisation which is due to their discoveries Science has lost the art of leadership, if it ever possessed it The scientist is afraid to be different, timidly afraid to accept the implications of the results of his own work and acquired knowledge, afraid to suggest that his own outlook of inquiry and patient observation, fearlessness to discard outworn or useless hypotheses, all of which be brings to bear on his own research, could with advantage be applied to our political, social, and economic institutions Perhaps, however, indifference and not fear is the cause of it

Mr Huxley may be justified in stating that " the real charm of the intellectual life—the life devoted to erudition, to scientific research, to philosophy, to æsthetics, to criticism—is its easiness " Easiness breeds indifference It is this indifference which makes for misunderstanding, for the oft expressed irritation of the non specialist with the specialist, and for the suggestion that the research worker—the really creative research worker—is less of an artist than other specialists—sculptors, painters, poets, and the like Mr Huxley gives me the impression that he has weighed science in his scales of human values and found it wanting But is science responsible for that ?

A G CHURCH

Archæological Investigation in Guernsey

The Archæology of the Channel Islands By T D Kendrick Vol 1 *The Bailiwick of Guernsey* Pp xxiv + 273 + 20 plates (London Methuen and Co , Ltd , 1928) 25s net

TO anthropologist and historian alike the Channel Islands are rich in interest The last vestige of the Duchy of Normandy—there the King is still officially the Duke—they possess a constitution of their own, and they have their own language, not a patois, but a lineal descendant of old Norman French, of which it retains the pronunciation and vocabulary, to the confusion of French speaking visitors The racial affinities of the inhabitants are by no means clear, though this is perhaps due to the fact that their physical characters have not been adequately studied A series of measurements taken in Jersey more than thirty years ago would not now be regarded as entirely satisfactory in technique, and the conclusions then drawn require reconsideration in the light of later theory It is, however, patent that at least two racial strains are present, a fair and a dark breed Cultural affinities with Brittany are present , and attempts have been made to show that the place names embody a Celtic element This latter contention is more than doubtful, and there is little convincing evidence for anything which cannot be derived from Norse or early Norman French For the affinities of the fair strain it is probable that we should look to the Norse type, and especially, in view of historical relations, through the Contentin, while connexion with Brittany may reasonably be correlated with the short, dark, long headed man who forms the substratum of the population on the north-western fringe of Europe The fair type, to the eye at least, appears quite distinct from the fairer Breton, who possibly may derive from a constituent in the later immigration of Celtic speaking peoples from Britain

The first volume of Mr Kendrick's " Archæology of the Channel Islands " deals only with the Bailiwick of Guernsey, that is, the Islands of Guernsey, Alderney, Sark, Herm, and attendant islets Jersey here obtains incidental reference only, and will receive attention in a second volume to be published later

The history of archæological discovery in the islands is exceptionally important in its bearing upon the nature of the evidence So many of the monuments and early finds have now disappeared that for our knowledge we are dependent upon the work of early explorers, and especially of F C Lukis, to whom Mr Kendrick's tribute and constant references do no more than justice The greater part of his record remains still in manuscript, but it has been used freely by the author, and it will always be the basis and starting point of any work on the archæology of the islands Lukis began his archæological investigations in the first decade of the nineteenth century, when he assisted in the excavation of the great passage grave of La Varde by Jean Gosselin, whose paper in *Archæologia* in 1811 is the first published reference to the prehistoric remains of Guernsey

Archæologically, the Channel Islands are profoundly interesting Though Guernsey and its attendant islands show no evidence of palæolithic man, in Jersey a human tooth discovered in a cave at St. Brelade's Bay bears witness to the extension of Neanderthal man to the islands Considering the area of the islands, megalithic remains were very numerous , they present certain resemblances to those of south-west Britain A large and important bronze hoard found in Alderney shows relation with the British Bronze Age, and a gold

torque found in Jersey is similar to those of Ireland It is probable, therefore, that the islands served as a gathering place and entrepôt along the lines of prehistoric trade This may explain the discrepancy between the numbers and distribution of stone axes and of megalithic monuments in the islands, the latter being most frequent in Alderney and Herm, while the largest number of stone axes, as might be expected, is found in Guernsey Mr Kendrick thinks that the islands of Alderney and Herm may have been regarded as specially sacred But Alderney at least, notwithstanding its dangerous sea passage, is on the obvious line of communication from the Continent to Britain, and it may be remembered that generally monuments, especially funerary monuments, tend to cluster around trade centres and along trade routes

The difficulties enumerated by Mr Kendrick of interpreting archæological evidence in any insular area are well illustrated in the Channel Islands The most reasonable inference is that they were, on the whole, intensely conservative over a long period, but along certain lines admitted local development Presumably this is the explanation of certain details in which the Channel Island finds are unique, such as the curious form of long nosed stone pick and a certain type of pottery Yet they were not entirely free from outside influence This is more marked in Jersey than in Guernsey, no doubt owing to the fact that within the period of human occupation an elevation of the land has twice joined Jersey to the Continent This would account for palæolithic culture being present in Jersey alone If influx took place at the time of the second elevation, as is suggested by the evidence, a knowledge of seafaring would then have enabled man to pass to Guernsey and the adjoining islands For there the history of man, so far as we know, begins with the megalithic period and the culture is predominantly megalithic throughout

The Guernsey group shows transition from the early Bronze, through the full Bronze, to the late Bronze and Iron Ages Yet progress throughout is along a line of development from the great communal burial places in the passage graves with which the cultural history begins It is influenced by outside relations rather than modified by the intrusion of a new civilisation Thus, though cremation appears in these islands, they have nothing to show like the round barrow and the Hallstadt cemetery of Jersey until the time of a La Tène settlement from Gaul in the century preceding our era On the other hand, the evidences of outside influence are many The absence of flint *in situ* and its occurrence in the form of beach pebbles only mark out the finer implements of this material, such as the Pressigny types, as imported One flint axe is of Scandinavian character The remarkable hoard of two hundred objects of bronze found at Longy in Alderney, already mentioned, includes many British in type But more marked are the relations with Brittany, to which constant reference has to be made throughout Mr Kendrick's text, justifying the conclusion to which he leans that the Channel Islands predominantly represent an outpost of the megalithic culture of that area

Among the more remarkable of the archæological remains described here are the statue menhirs carved in the representation of a human female form—a type of the mother goddess A carving on the underside of a stone roofing a megalithic monument from its position—part of the carving overlies the upright on which it rests—is obviously older than the structure of which the stone forms part These statue menhirs are sometimes called 'neolithic,' but, after a comparison with similar monuments elsewhere, notwithstanding their archaic appearance, the author is inclined to consider their age as uncertain

Mr Kendrick has marshalled his facts with consummate ability, and makes them tell a consistent story so far as they carry him within the limits he has set to the subject matter of this volume For his discussion of their broader relations we must await his second volume

Nitroglycerine Explosives.

Nitroglycerine and Nitroglycerine Explosives By Dr Phokion Naoum Authorised English Translation, with Notes and Additions by E M Symmes (The World Wide Chemical Translation Series, No 1) Pp xi+469 (London Baillière, Tindall and Cox, 1928) 31*s* 6*d* net

THE translator of Dr Naoum's well known work has rendered useful service in making it available to a wider circle of readers, containing as it does a fuller collection of information on its subject than any other work in the English language Originally published in Germany in 1924, it gives an account of the great industry built on the foundations laid in 1847 by Sobrero, the discoverer of 'nitroglycerine,' and by Nobel, who in 1862 first commenced its manufacture on a technical scale Not only is this substance of great value to humanity for peaceful purposes, but it is also of vital importance in the manufacture of propellants as munitions of war, to an extent probably not

foreseen by Nobel, the founder of the Nobel peace prize, who died in 1896

The claim of the author of this book to include "all matter worth while on the subject" is not fully justified, in view of the omission of information on developments in this branch of explosives technology which became available in the years preceding and immediately following the War To a slight extent this has been remedied by the translator by the insertion of numerous footnotes, but these are extremely brief, and for the most part refer to differences between German and American practice The origin of the book is evident from the occasional presence of such phrases as "the never to be wholly avoided blown-out shots," but with very few exceptions the translation is excellent

Following a short historical summary of the development of the nitroglycerine and dynamite industry, the book is divided into three parts, the first of which deals with the manufacture, uses, and properties of nitroglycerine On page 11 we read the surprising statement that "nitroglycerine explosives as munitions achieved little importance," but on the next page we find that "In the World War nitroglycerine was the most indispensible [*sic*] component of munitions"

The manufacture of nitroglycerine as carried out in Germany at the works of the Dynamit A G vorm Alfred Nobel, of whose central laboratories in Hamburg Dr Naoum is director, is fully described, but only very brief footnote references are made to the very different practice followed in the U S A The Nathan, Thomson, and Rintoul nitrator separator process used in Great Britain and elsewhere is described with the aid of a diagram from which the reference letters mentioned in the text are omitted In the chapter referring to the denitration of spent acids, the references are all to early pre War plant, and make no mention of the developments made during the War, records of which were available in 1920 The same criticism applies to the chapter on the physical and chemical properties of nitroglycerine as an explosive, no reference being made to modern methods of measuring explosion pressures by the application of the Hopkinson pressure bar, and the piezo electric gauge

Part 2 contains a description of the preparation and properties of homologous and related nitric esters, many of which possess valuable properties from the thermo-chemical point of view, but have failed to find a permanent place in the explosives industry owing to their high cost of production, or defective properties of volatility, hygroscopicity, etc Of special interest are those esters used in the production of 'non-freezing' explosives, of these, 'nitroglycol' has only recently become an economic possibility, owing to the development of methods for the manufacture of ethylene glycol from the ethylene in natural gas

Part 3 details the manufacture and properties of the numerous series of explosives containing nitroglycerine which are used for blasting purposes, but does not include the non brisant mixtures used as propellants The mis-translation of 'brisanz granaten' on p 281, as 'brisant grenades,' gives rather a restricted impression of the importance of trinitrotoluene–ammonium nitrate mixtures as shell fillings during the War The development of gelatinised explosives following on Nobel's discovery of the gelatinisation of nitrocellulose by nitroglycerine marked a great improvement on the dynamite type of explosive, and finally led to the introduction of smokeless propellants containing nitroglycerine A brief description of the manufacture of nitrocellulose or collodion cotton for this purpose omits all mention of the Nathan and Thomson displacement pan method, which was introduced more than twenty years ago, and has since been widely used

The description of ammonium nitrate as an endothermic explosive compound, and of tetryl as tetra nitromethylaniline, should be corrected in future editions

A large number of tables are given showing the composition and properties of nitroglycerine explosives, but these have not all been brought up-to-date, for example, out of eleven British Permitted explosives quoted, only three are now on the Permitted list

The book is well printed, and contains few printers' errors With the reservations mentioned above, it can be recommended to all who are interested in the development and products of the nitroglycerine and nitroglycerine explosives industry

R C G

The Mechanism of the Nervous System

The Basis of Sensation the Action of the Sense Organs By Dr E D Adrian Pp 122 (London Christophers, 1928) 7*s* 6*d* net

IT is not always easy to induce the worker who is making great discoveries to put them into a book and the thanks of the scientific world are due to the University of London for persuading Dr Adrian to give last year the short course of

lectures which formed the starting-point of this little monograph

Of all the work recorded in the field of physiology in recent times, none is more beautiful in itself, more striking in its historical derivation, more pregnant with possibilities of future development, than that which Dr Adrian with such engaging modesty and humour describes herein To have heard the roar in Dr Adrian's loud speaker of the amplified afferent impulses flowing up from the heart in the depressor nerve, to have seen the sensory waves in a single nerve fibre from the frog's skin chasing each other like little imps across the screen of Matthews' oscillograph, is to have one's imagination stirred by the progress which has been achieved in the last few years in knowledge of how the nervous system works, and by the picture of the complex scurrying activity on which sensation and consciousness are built The scientific basis of this achievement is described very shortly but very clearly and with great charm in this book

It has long been realised that a state of continuous activity cannot be produced in a nerve by artificial means The only form of message known to occur in a nerve was that of which the fundamental unit is the single nerve impulse, a short wave propagating itself at high speed by what are presumably electro chemical processes The activity of a nerve was no more continuous than that of a machine gun the frequency with which its messages could be carried was similarly limited, after a single impulse, a 'refractory' period occurred during which no other impulse could pass No proof, however, was at first forthcoming that natural activity in the living body did not invoke another kind of process, one of a continuous nature not involving a stream of discrete waves in the transmitting medium It is still not certain that such continuous states of activity do not occur it *is* certain, however, that a large part of the normal functioning of the nervous system depends upon a succession of separate impulses in the nerve fibres exactly similar in nature to those evoked by the physiologist in his studies of isolated nerve For some years this conclusion has been obvious for the case of motor impulses to the skeletal muscle Dr Adrian has made it equally certain for the afferent impulses from the sensory end organs, and in recent work (not referred to in this monograph) has discovered how contractions are graded by the frequency of the impulses which reach the muscles along their motor nerves

In 1914, Keith Lucas delivered a course of seven lectures at University College, London, and these, after his death at Upavon in 1916, were embodied in a book, "The Conduction of the Nervous Impulse," in a foreword to which Dr Adrian speaks of himself as "one whose pride it is to regard himself as a pupil of Keith Lucas" Dr Alexander Forbes, of Harvard, would with equal pride regard himself as a pupil both of Lucas and of Sherrington, and he was among the first to show objectively the discontinuous nature of the afferent messages of the proprioceptive system The justice of this pious regard for Lucas's memory will be seen in Dr Adrian's own book, where, suitably modified in the sensory organs, those properties of the nerve fibre which Lucas discovered are shown to be "the basis of sensation" In its skill and subtlety, in the judgment and ingenuity displayed in experiment, no less than in the fineness of its exposition, the work of Adrian is a worthy memorial to Lucas

The achievement of recording a single wave of action potential in a single nerve fibre, which is the ultimate basis of this work, was made possible by modern developments in valve amplification In Dr Adrian's words "It is now possible to work with a 5000 fold amplification on an input change of a few microvolts without danger of interference from unsteadiness in the amplifier" He pays an amusing tribute to the importance of the amplifier in his work "When the academic scientist is forced to justify his existence to the man in the street he is inclined to do so by pointing out the essential part played by academic research in the development of our modern comfort It is only fair, therefore, to point out that in this case the boot is on the other leg and the academic research has depended on the very modern comfort of broadcasting"

Dr Adrian's work, however, will not be allowed long to remain without its own applications It is interesting to find how this, the most academic branch of scientific physiology, pursued for purely scientific ends, has suddenly in Dr Adrian's hands broken out into a region where neurology and medicine cannot fail, in a few years, to gain much by contact with it Within a short space of time it may well prove as fundamental as the work of Sherrington and Magnus To a mere physiologist it would seem that psychology also might have much to learn from it How do our sensations differ in intensity? By the frequency of the impulses started in the end organs How do we 'get used' to external changes? By the 'adaptation' of the end organs, which is seen in its extreme form in the nerve fibre itself In Chapter vi, Dr Adrian deals gently with behaviourists on one hand and idealists on the other he is much too clever

to take sides with the one or the other, and after poking fun at the statement that "the brain secretes thought as the liver secretes bile," he concludes that "it does not matter very much whether we regard the relation of matter to mind as inexplicable or as needing no explanation" "There is a relation of some kind between nervous impulses and sensation, and we can discuss this without attempting to decide how, or whether, the one can 'cause' the other" After which he returns, in the manner of physiologists, to a consideration of the facts of his experiments A V Hill

Our Bookshelf

(1) *How you Began a Child's Introduction to Biology* By Amabel Williams Ellis Pp 96 (London Gerald Howe, Ltd, 1928) 2s 6d net
(2) *A First Biology* By Prof S Mangham and Prof W Rae Sherriffs Pp viii + 184 (London Sidgwick and Jackson, Ltd, 1928) 2s 6d
(3) *Fundamentals of Biology* By Prof Arthur W Haupt (McGraw Hill Publications in the Zoological Sciences) Pp xii + 358 (New York McGraw Hill Book Co, Inc, London McGraw Hill Publishing Co, Ltd, 1928) 15s net

These three volumes may all be said to be books intended to introduce biology to pupils in schools Mrs Williams Ellis's book is intended for young children of about seven or eight years of age The volume by Mangham and Sherriffs is supposed to be for older boys and girls before they enter a university, whilst Dr Haupt's "Fundamentals of Biology" is a reprint of lectures given to freshmen in New York, but the intellectual level attained by American freshmen is lower than that attained in the upper forms of the science side in schools in England

Mrs Williams Ellis's book is preceded by a flattering introduction by Mr J B S Haldane The book is beautifully written, and is an attempt to describe to young children the general course of human development interpreted in the light of the recapitulation theory, and the view that the essence of life is striving or desire The child is told that he played at being a fish before he decided to become a man, and so on Mr Haldane considers that Mrs Williams Ellis's account of evolution is more nearly correct than those recently published by two scientific men We do not know to what accounts Mr Haldane refers, but Mrs Williams Ellis's account resolves itself into 'chance variations' The late Dr Bateson said "there are only two possible explanations of variation—chance, or the reaction of the animal to the environment" We prefer the latter, and believe that Mr Haldane will also in the course of time

The other two volumes give a mixture of chapters on animals and plants, and we suppose that the authors imagine that this is the easiest method of initiating young people into the study of biology Many school teachers are, as a matter of fact, obsessed with this idea Nevertheless, we hold that it is a profound mistake That animals and plants are ultimately derived from the same stock, no biologist would deny there is a level—that of the Flagellata, where they grade into one another From this starting point, however, evolution has pursued totally different courses in the two kingdoms, and it is most confusing to place side by side, as Mangham and Sherriffs do, reproduction in the higher plants with its concealed alternation of generations and that of animals Haupt is not so blameworthy, for he gives a rapid sketch of plants just before proceeding to animals The only proper way to study either animals or plants, in our opinion, is the way introduced by Huxley, namely, the examination of a series of types, and as we are animals and not plants, it is easier to begin with animals and then proceed to plants Haupt, as might be expected from New York, devotes a disproportionate amount of space to Morgan and *Drosophila* We hope that after Miller's exposition of the pathogenic character of the *Drosophila* mutations, this nightmare will gradually vanish from elementary text books as an illustration of the "fundamental laws of heredity" E W M

Truck Crop Plants By Dr H A Jones and Dr J T Rosa (McGraw Hill Publications in the Agricultural and Botanical Sciences) Pp xiv + 538 (New York McGraw Hill Book Co, Inc, London McGraw Hill Publishing Co, Ltd, 1928) 25s net

Vegetable growing on a large scale at some distance from a market has assumed such proportions in the United States that certain universities have established divisions of 'truck farming,' to guide the development of the system along the most economical and profitable lines both as regards cultivation and marketing The economics of the manuring of truck crops is still in the experimental stage, but the growers are fully alive to the importance of controlling insect and plant pests

Owing to the distance from market, the appropriate selection of crops is all important, in order to obtain the essential correlation between the adaptation of the crops to soil and climate and the expected time of marketing The development of truck farming has largely run parallel with improvement in transport systems, and the installation of refrigerating cars has done much to open up still more distant markets As the crops are perishable, there is danger of loss from over supply, and the possibility of competition between truck crops and the local supply in any district needs careful consideration It seems probable that future advance in truck farming lies in production at lower costs rather than in higher selling prices, entailing concentration on intensive cultivation on land already cleared

The variety of crops suitable for the purpose is somewhat limited, the most important genus being *Brassica*, which alone provides many species of

great economic importance The general methods of treatment of each crop, from seed to harvest, vary considerably, and are outlined in this volume, sufficient illustrations and tables being provided to emphasise the salient points in crop development, manuring and marketing, and to provide a useful guide to the reader

(1) *Rovers and Stay at Homes* By Maribel Edwin Pp v+181 (London and Toronto J M Dent and Sons, Ltd, New York E P Dutton and Co, 1927) 5s net

(2) *African Jungle Life* By Major A Radclyffe Dugmore Pp viii+246+8 plates (London Macmillan and Co, Ltd, 1928) 15s net

(1) IN these short tales, Mrs Edwin has succeeded in capturing again the fine feeling of her earlier book The stories are written for young children, and are marked by delightful simplicity of word and narrative Each story gives a charming and accurate impression of the ordinary life story of a common British creature—seal, sparrow, rat, sea gull, eagle, and red deer are typical samples Lively pen sketches by M M Howard decorate almost every page, but the artist has an exaggerated notion of the amount of leg which a Scottish kilt may properly expose

(2) Major Dugmore has chosen a series of silhouettes of African jungle life, and round them has written and illustrated a book which, while not specifically addressed to the young, will entrance both them and their elders His personal touch with the jungle gives vividness, freshness, and accuracy to his stories of the adventures of the selected creatures—elephant, lion, buffalo, rhinoceros, and giraffe—and it is gratifying to read of the success which restrictive game laws, animal reserves, and, not least, enlightened public opinion, have had in preserving the wild fauna and increasing the numbers of innocuous creatures like the giraffe

Major Dugmore is less happy in his arguments against the advocates of protective coloration, though his actual experiences must be given due weight, when, for example, he suggests that the winter change of the Arctic hare is not protective, because the hare retains its black eye, he forgets that a black eye is surely less conspicuous in snow than a complete brown hare, and that the pigmentation of the retina is an essential to the best vision

The Earth and its Rhythms By Prof Charles Schuchert and Clara M Le Vene Pp xvi+410 (New York and London D Appleton and Co, 1927) 15s net

OF the many recent attempts to present popularised geology to the general reader, most of which have come from the United States, this is undoubtedly by far the most successful The book is attractive in style and make-up, beautifully adorned with illustrations, well proportioned in its matter, and authoritative in its facts. The authors are fully aware of the difficulties that stand in the way of interpreting the processes of geology and the principles of evolution and earth-history to the non scientific mind They point out that the book is not intended for the geological purist, and that if there are generalities that may offend him, he can best spend his spare time in explaining the exceptions that outcrop in the field of generalisations

The geological purist may, nevertheless, safely recommend the book to any of his friends who may wish to absorb from our common intellectual heritage some knowledge of the record of the rocks A little more than half the book deals with the architecture of the earth's crust, the fashioning of the raw materials into scenery, and the endless interplay of internal and external agencies A chapter on geological time then introduces the dark ages of earth history, and the remaining chapters describe the dramatic procession of life with the skill that is to be expected of Prof Schuchert The book concludes with chapters on the ice ages and the coming of man Authors and publishers are to be congratulated on a co operation that has notably enriched the popular literature of science

The Ramblings of a Bird Lover By the Rev Canon Charles E Raven Pp xvi+186+31 plates (London Martin Hopkinson and Co, Ltd, 1927) 10s 6d net

AFTER reading this book, the two things the reader finds impressed upon him are these first, that the author will insist on commencing most of his sentences with 'and' and, secondly, in spite of the weakness of his English, how very charming it all is One finds that Mr Raven can turn the catching of a gurnet into a poem of bliss, or can write a most interesting article on fish bait All that the author tells us in his book are things most of us knew in our early childhood, yet he awakens in us a fresh delight in our own knowledge

The illustrations are almost as charming as the letterpress The printing is good, and the general get up of the book quite satisfactory If the reader is irritated by the 'ands' when he starts reading, by the time he puts the book down he will be only too anxious for more

Practical Vegetable Growing By J W Morton Pp 180+8 plates (London Ernest Benn, Ltd, 1928) 10s 6d net

THIS is an excellent book, by an author who understands the practical side of the cultivation of vegetables We are in agreement with his comment that far more knowledge may be definitely obtained from careful reading than is realised by the majority of those whose living depends upon the land Here there is much to be gleaned that will encourage the market gardener, as well as those who work on allotments or maintain small garden plots in outer London and suburban areas Cultivators in the last category are increasing in number without doubt, and have a special freemasonry of their own to boot

The book has several useful illustrations, whilst the vegetables dealt with have been taken in alphabetical order There is a satisfactory index

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Oscillation in Ultrasonic Generators and Velocity of Longitudinal Vibrations in Solids at High Frequencies

THE increasing use of piezo electric quartz for the stabilisation of radio frequencies has promoted many investigations of the vibration of the quartz. In the last few years a mass of information has been accumulated disclosing the complexities of vibratory modes and types which may exist simultaneously in one and the same crystal plate or rod. Along with the longitudinal, flectural and torsional oscillations may exist, as well as overtones of any or of all. In this connexion mention may be made of the experiments of Cady, Tawil, Dawson, Harrison, Hund, Giebe and Schiebe, Meisener, Ny Tsi Ze, Crossley, Dye, and others.

FIG 1

It is obvious that if the quartz is cemented to metallic plates or rods, as in ultrasonic generators, when vibrating it can transmit its motions to these bodies, and at very high frequencies, in the plates or rods themselves additional complicated oscillations may arise. A result is that often irregularities of distribution of amplitude, energy, and phase exist at the face of any ultrasonic radiator. Experimentally this was shown by the writer and assistants (*Trans Roy Soc Can*, **19**, p 187, 1925) by surveying the energy distribution near the face of an ultrasonic generator operating in water, frequencies around 140,000 cycles per second.

A study carried out in this laboratory last year by Mr Sproule on the behaviour of dust particles on the ends of vibrating metal rods, held vertically, and set into high frequency vibration by active quartz, revealed interesting examples of very complicated vibratory types. At certain resonant frequencies the dust arranged itself in patterns similar to some of Chladni's figures, four, six, eight, and twelve pointed stars could be obtained. At certain frequencies the particles were observed to move continuously in a circle about the centre of the section, sometimes those near the outer edge moving in a clockwise direction and those nearer the centre moving anti clockwise. At times little whirls of dust were formed off centre. Evidently torsional vibrations and radial vibrations of other types could be set up in the rod. The photograph (Fig 1) shows an example of an 8 pointed star so obtained. Here the rod was of duraluminum 5 1 cm in diameter and 48 1 cm long, frequencies of experiment ranging from 84,000 to 140,000 cycles per second.

Such work shows that very cautious judgment must be exercised when determining a resonant frequency, particularly the overtones, of any vibratory type, and mathematical computations of energy output, based on theoretical data alone, or on measurements taken near the radiator, or in any confined space in which the radiatory operates, may easily be misleading.

However, in the case of longitudinal vibrations of a rod of solid material set into high frequency oscillation by a piezo electric plate, this method may be used, with due caution, to determine the velocity of sound in, and Young's modulus of, the rod at the frequencies of the fundamental note and lower overtones. Pierce, by setting rods of metallic alloys into longitudinal vibration by magnetostrictive action, has recently carried out very precise determinations of the same kind (*Proc Amer Acad Arts and Sciences*, vol 63, No 1, April 1928).

For the natural modes of vibration of a free rod the length of the rod is equal to an integral number of half wave lengths ($l = k\lambda/2$), and the velocity $V = \sqrt{E/d}$ when the rod is thin (r/l small, for a circular section). But possible corrections may have to be applied in case of varying frequency and changing ratio r/l on account of the lateral inertia of the rod. For example, Rayleigh's correction ('Theory of Sound' vol 1, p 252, ed 1894) makes the velocity a function of the mode of vibration, Poisson's ratio, and (rk/l). The work last year on the velocity of ultrasound in metallic rods of different proportions, using the method of high frequency piezo electric excitation indicated where the correction for lateral inertia should be applied (*Science Progress*, **89**, p 92, July 1928). For example, with duraluminum, for $(rk/l)^2 < 0\ 07$, the effect of lateral inertia is inappreciable and the velocity may be computed from $V = \sqrt{E/d}$. In the range $0\ 07 > (rk/l)^2 < 0\ 3$ Rayleigh's expression gave the velocity approximately enough for most purposes, but for $(rk/l)^2 > 0\ 3$ the types of vibration could not be distinguished, the frequency of successive modes of any type followed no apparent law, and no known formula for velocity could correctly be applied.

Frequencies of 8000 to 200,000 cycles per second here were used with duraluminum rods of length varying from 4 1 to 61 cm and radii of section from 0 63 to 2 55 cm.

Incidentally, the method was applied to determine Young's modulus of ice, for use in association with other problems. This physical constant is most uncertain in quoted values by other methods, but by the present method of high frequency longitudinal vibration it can be easily and quickly determined. The velocity of sound in ice just below 0° C was found to be $3\ 2 \times 10^5$ cm per second and does not vary much with changing temperature or direction in the crystal. This velocity gives a value for Young's modulus of $9\ 36 \times 10^{10}$ dynes per sq cm.

R W BOYLE
D O SPROULE.

University of Alberta,
Nov 17

Reproduction and Death in Invertebrates and Fishes

IN NATURE some time ago (115, 155, 1925) Dr Bidder raised again the interesting fundamental question of the cause of normal death in aquatic animals, and stated that so far as he knew there was no evidence of any marine animals dying a natural death, except those whose life is ended by the winter or the summer Later, the same writer, after reviewing earlier discussions (*Proc Linn Soc*, 1925, p 17), argued that we have no reason to suppose that aquatic animals, such as plaice, carp, and sea anemones, ever die except by violence It was stated that though both man and plaice, for example, increase by approximately geometrical progression in weight until the age of puberty, man after the age of twenty eight declines in (significant) weight and must die, whereas plaice continue to grow indefinitely by positive increments, from which fact it is deduced that life in plaice—and similar animals—may be eternal The renewal of interest in this subject is already producing practical results, and it is worth while discussing some other aspects of the problem

The marine naturalist who sees populations of sponges, hydroids, worms, molluscs and echinoderms, and fishes, come and go, can scarcely resist the impression that the life period is more or less proscribed in some way for each kind The final violent effacement of soft bodied marine animals may probably be agreed upon, but such may be only an unimportant effect of a preceding condition of moribundity, the inquiry may therefore be directed towards the possible conditions which may induce moribundity In the first place, why do animals and other short life period animals die ? A reasonable answer is that this kind of animal dies as a result mainly of expending itself in reproduction, there may often be other contributory factors, but these may be regarded as of a second order of importance In this type of death it would appear that the constitution of the animal is such that under certain environmental conditions the metabolism is concentrated overwhelmingly on reproduction, we may therefore define the (proximal) cause of death in such cases as the concomitance of the particular organic constitution with particular environmental conditions (R Pearl in "Biology of Death," 1922, expresses a similar conception) For the sake of simplicity we may term this as death from *over reproduction* This fundamental conception of death—or moribundity—may be applied especially to marine invertebrates and fishes, to inquire whether reproduction may be a general predisposing cause of death in a less obvious manner than in the case of those animals whose life period is brief

The phenomena of death in the sponge, *Grantia compressa*, which disintegrates after becoming almost a mass of larvæ, may serve as a typical example of probable death from over reproduction (in Child's terminology ("Senescence and Rejuvenescence," 1915) one might perhaps use the term over senescence) Death in nudibranchs, jelly fishes, many isopods, polychætes, some shore fishes, and no doubt many other forms, may readily be interpreted in the same way Species which exhibit this form of death are, however, adapted to their environment and survive, but are subject to great fluctuation in numbers from year to year Other species, which do not die after the first or earlier phases of reproduction, normally pass through a recuperative stage, persisting in either a functional state, or avoiding metabolic unfitness by hibernating or æstivating, and may afterwards begin growth again Nevertheless, the reproductive phase comes around again periodically, and it becomes necessary to know whether, later in life, reproductive activity increases at a greater rate than can ultimately be borne by the bodily increments between successive periods of reproductive activity

It should be possible in many cases to express these two factors, for example, bodily increments, and increments in reproductive elements, in terms of weight, as Fullarton and—later—Miss Mitchell did in pioneer studies on a few fishes (Fishery Board for Scotland, 1908–1911, Cd 6950), if it be found in this way, for example, that the acceleration in weight of the spent body eventually becomes significantly smaller than that of the spent body plus the reproductive elements, then, either death will follow from over reproduction, as in *Grantia*, or what in practice is the same, the animal may become so unstable in its reproductive equilibrium that any accumulated sub lethal factors along with the normal rigours in the environment—

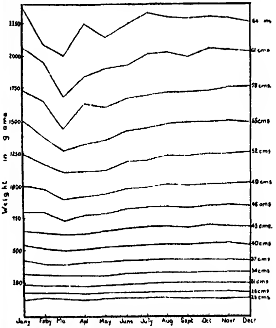

FIG 1 —Seasonal variation in weight of gutted haddock at Grimsby 1910–11 (after E S Russell) Reproduced by courtesy of Dr Russell and permission of the Controller of H M Stationery Office.

especially those occurring at about the time of reproduction—may cause such unfitness as, in the sea, must result in death

The remarkable increase in amplitude in reproductive activity with age implied in Russell's observations (see Fig 1) (Fish Invest II 1, 1924) on the haddock, along with somewhat similar demonstrations in plaice by Masterman (Board of Agric and Fish Cd 5686, 1911) and D'Arcy W Thompson ("Growth and Form," Cambridge, p 100), illustrate how reproduction may eventually overbalance normal metabolism and result in death Russell indeed suggests that in the larger haddock the gonad probably forms a *relatively greater* proportion of the total body weight than in the smaller fish Other fishes and invertebrate aquatic animals may be expected to provide information of a similar type, so that it may be possible when significant data are known to fix the average probable age of death in particular cases for such epitomes of the reproductive life history, as that of the haddock shown above, may give the rate of increase in amplitude of the pendulum of senescence to a true critical point

In marine invertebrates and fishes there is good ground for regarding breeding as a compulsory rhythm in the healthy individual, and that as a result there is apparently no escape from the periodically increasing strain of the reproductive cycle (accumulative senescence ?) If, on the other hand, we assume that breeding ceases in marine animals at an advanced age, we are probably admitting that death will follow, for a marine animal which is incapable of breeding is already (in a restricted sense) biologically dead, the longevity of some aquatic animals in confinement may perhaps be due to their avoidance of the reproductive strain The rate of increase in reproductivity with age in other marine animals than fishes is a relatively unknown subject, but in many forms valuable information could easily be acquired

From my own data (*Jour M B A*, 15, 2, 1928) on the oyster there is a strong indication that the weight of sexually mature individuals up to an age of about seven years increases at a greater rate than that of sexually spent individuals (taking similar estimated ages as a criterion of similar sizes), so that the amplitude of reproductive activity may be expected to increase with age in the same way as in the haddock, and life will apparently—or perhaps must—become unstable at the weakest point in the reproductive cycle (*sic*) at about the spawning time On the difficult subject of normal mortality there is in the oyster—as in some other forms—probably a maximum at about the spawning period Enough has perhaps now been presented to focus attention on the probable importance of over reproduction—along with other contributory factors—in predisposing or causing death in marine animals A collection of figures and facts—and especially facts regarding physiological states—is now required to bear on the problem before proceeding further, and in any event, mathematical expressions of the rate of reproduction (as defined) in a variety of aquatic animals would provide information of much general interest J H ORTON

Marine Biological Laboratory,
Plymouth, Nov 13

Rotation of the Earth and Magnetostriction

IN 1926, Prof E W Brown presented the evidence indicating remarkable changes in the rate of the earth's rotation (*Trans of the Astronomical Observatory of Yale University*, vol 3, part 6) Changes, more or less abrupt, were shown to have occurred about 1785, 1850, 1898, and 1918 Prof Brown finds that the observational data are consistent with the hypothesis of an oscillatory change in the earth's mean radius Why the earth should expand and contract, he makes no suggestion, but gives a study of the occurrence of earthquakes, which, however, shows no well defined correlation He cites a theory of Prof Joly (*Observatory*, February, 1926) that the vertical oscillations of the earth's crust may be caused by a thermal effect of radium acting in a substratum of basalt

Prof W de Sitter has discussed the relation of the earth's rotation and astronomical time in NATURE (Jan 21, 1928, page 99) To satisfy the observations, he combines the effect of changes in the size or shape of the earth and the variable force of tidal friction He does not explain what may expand or distort the earth

I have taken considerable interest in the variable rotation of the earth, and recently have tried to relate it with magnetostriction Why may not the earth pulsate under varying magnetic force ? An iron bar may be lengthened a millionth part by magnetisation even in a moderate field In stronger fields it suffers contraction, but we are not concerned with such fields Now the earth has an iron core at the centre, which may perhaps be expanded by increase of magnetic force With expansion, the earth's rotation would be retarded It might be that the increase of the earth's diameter would be in the line of the magnetic poles However these are far enough from the axial poles to produce some effect It may be questioned how much of the iron core, on account of its heated condition, might become magnetised If the magnetisation is at the periphery of the iron deposits surrounding the core, that may accord with one of the calculations of Brown, in which changes in pressure are conceived as taking place in an outer stratum

Of the measures of terrestrial magnetism, observations of the declination are in general the most trustworthy In seeking a correlation, it seemed best to use the secular change *Special Publication of the U S Coast and Geodetic Survey* No 126, gives the change in declination with time for places distributed over the whole of the United States at intervals of 2° of latitude or longitude The secular change was easily derived by taking differences of the tabular values I have plotted curves for many of these stations, using the secular change (+ to west) for 10 year intervals Although many shifts and variations occur for different parts of the country, yet there are three striking features A pronounced minimum occurs in the vicinity of 1900 A maximum is found near 1850 for eastern sections, and about 1890 for western sections On many of the plots we find another maximum about 1920 It seems remarkable that these maximum or minimum points should occur so near the dates found by Brown for changes in the length of the day I have studied also data for a few stations in Europe with similar results

Some of these changes have been noted elsewhere Chree (" Enc Brit," vol 17, page 359) remarks "The rate of movement of the needle to the east at London —and throughout Europe generally— fell off markedly subsequent to 1880 Thus in 1902 it was at least open to doubt whether a change in the sign of the secular change were not in immediate prospect Subsequent, however, to that date there was little further decline in the rate of secular change, and since 1905 there has been a very distinct acceleration " Discussing further, in particular concerning the anomalies of secular change in the United States, he writes " Auspices do not all point one way, and the future is as uncertain as it is interesting " Since that time we have had the maximum which set in about 1920

Much work has been done at various places to relate sunspots and magnetic declination Without expecting much, I have put together sunspot data Plotting curves of Wolf's sunspot numbers, and then connecting maximum points, the curve so drawn shows a minimum about 1905 This proves very little, as a still lower point of the curve occurs about 1804 and 1816

It must be said concerning the hypothesis of magnetostriction producing oscillations in the earth's diameter that the force of the magnetic field of the earth is quite weak Moreover, the interior of the earth contains not only iron but also nickel, which contracts in all magnetic fields These are complicating factors The correlation between the secular changes in declination and the change in the rate of the earth's rotation appears important It may be that the changes in declination are pressure effects arising from the slight adjustments of the structure within the earth The rearrangement of the strata sufficient to produce the changes in the length of the day, might also, by magnetostriction, affect the earth's magnetic conditions We would then be dealing with results from a common cause

The whole question is of great interest, and I shall pursue the inquiry further Meanwhile, I have written this note in the hope that others, better acquainted with the magnetic and geophysical aspects of the problem, may pass their judgment

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Nov 21

Oxide Films responsible for the Tints on Heated Copper

MUCH has been published on the tints of heated copper, but disagreement prevails regarding the oxide responsible for the colours, Dunn (*Proc Roy Soc*, 111 [A], 211, 1926) apparently attributes them to cuprous oxide, and Constable (*Ibid*, 115 [A], 583, 1927) to a "veneer of cupric oxide" Recently the oxide films have been isolated from their basis, the metal being dissolved from below by anodic treatment in concentrated potassium sulphate solution, the oxide films, thus undermined, peel off in curling flakes, which retain the grooves and ridges left by the abrasive treatment used to clean the copper before oxidation The thicker films can also be removed mechanically

The two oxides present in the films are quite different in appearance and can be distinguished by chemical tests At thicknesses above the interference colour range, cuprous oxide films appear brown by transmitted light and exhibit by reflected light a characteristic colour best described as pale chocolate, but a veneer of cupric oxide produces a dark grey reflex without a trace of brown or red Residual metallic copper, where it exists in the films, has a bright red lustre and is opaque, its presence may be revealed by the action of silver nitrate, which produces a microscopic 'silver tree'

It has been found that the colours are due to cuprous oxide Cupric oxide is indeed formed under strongly oxidising conditions, but it obscures the colours, and must be avoided if the later tints are to be obtained Thus Constable, working under conditions favourable to the production of cupric oxide, obtained no colours beyond the middle of the second order, the tints darkening and passing into the black characteristic of cupric oxide This has been confirmed, but it was found that if the formation of cupric oxide is avoided, the sequence can be followed to the fourth order, the tints then pass gradually into the characteristic colour of cuprous oxide The easiest way to prevent the formation of cupric oxide is to use a *mildly* oxidising gas mixture—preferably obtained from a flame of pure alcohol

Within the interference colour range, the cuprous oxide films are quite transparent On the whole, the oxide film taken from copper tinted to an early colour is more transparent than that taken from copper displaying a high order tint, but in the latter case fragments of thin, highly transparent films are also separated along with the thicker skin This is apparently due to the fact that the skin cracks as it thickens, allowing air access to the metal exposed at the crack, so that another film is formed below the first, this lower film will be generally thinner than the first and will diminish in thickness with the distance from the crack The formation (at a crack) of one skin below another has been directly observed at high temperatures, and there is evidence that the phenomenon is general, for it is found that copper heated rather too strongly for interference colours nevertheless yields—on stripping—flakes which display bright colours, the tints varying from place to place as the result of varying thickness

The colours of the stripped films are often brilliant by reflected light, rose, blue, and green hues being obtained, by transmitted light the interference tints are largely masked by the yellow hue due to selective absorption, but there is a slight variation of colour with thickness between yellowish green, bright yellow, and brown

The films isolated from copper tinted to the early first order colours usually contain opaque spots due to included metallic copper, and the metallic residue increases on passing to films taken from copper heated insufficiently to produce colours In films removed from copper merely exposed (after abrasion) to dry air at *ordinary temperatures*, the opaque areas generally predominate over the transparent areas although the character of the composite oxide metal layer varies with the nature of the abrasive treatment employed The composite layer appears to be formed as follows Abrasion produces a network of cracks, increasing the true surface area as found by Bowden (NATURE, 112, 647, 1928) On exposure to air, the walls of these cracks become oxidised, and the internal oxide sheaths obstruct to a large extent the anodic removal of metallic copper, so that the layer left (after the unchanged basis has been dissolved away) consists of both metal and oxide Clearly with increasing temperature or time of exposure to oxygen, the proportion of residual metal in the layer stripped will diminish, and hence the films obtained from copper tinted to any of the later colours are practically free from metal

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Radio Echoes and Conditions for their Occurrence

SINCE October 24 the emission of signals (see NATURE, Nov 3 and Dec 8, 1928) from the short wave emitter PCJJ (Holland) has been continued twice a week, and sometimes more frequently Through the Norwegian Telegraph Office a series of receiving stations has maintained a continual watch, and an oscillograph has been ready for use at all times, but no echoes have been heard, either in Norway or in Eindhoven

It appears from this, and from the long silence during experiments in the spring and summer, that the echoes constitute a very rare phenomenon and owe their occurrence to a series of favourable coincident circumstances The wave length must be the most favourable one and the emission must be sent out in the right direction and with sufficiently great energy (A transmitter station in the tropics would probably be better than a station in Holland) The Kennelly Heaviside layer must be penetrable by the outgoing and returning waves, and must also be favourable for the hearing of both signals and echoes, and the receiving apparatus must be sufficiently sensitive and exactly adjusted

Further, there must be good conditions for hearing without too many atmospheric disturbances, and, last but not least the emission of electrons from the sun must take place in such a way that reflecting surfaces in space outside the orbit of the moon may be formed and may have the most favourable shape for a good reflection of the waves

As regards the last point, the mathematical theory of the motion of electric corpuscles around a magnetised sphere shows that the chances of obtaining a well defined toroidal space round the earth are good when the direction to the sun lies near the magnetic equatorial plane (perpendicular to the magnetic axis)

This result is in close agreement with a remarkable experiment made by the late Prof Birkeland [1] which is reproduced in Fig 1

Here cathode rays are sent from an aluminium plate near the magnetic equatorial plane of the magnetic sphere, and a part of the toroidal space is very well seen with corners of rays descending to the polar regions of the sphere, corresponding to the

FIG 1—Cathode rays in relation to a magnetised sphere

production of polar auroræ On the two occasions, Oct 11 and 24, when echoes were heard, the sun was not far from the earth's magnetic equatorial plane But such favourable occasions disappeared towards the end of October and will not recur before the middle of February Thus, if this explanation of the most favourable situation of the sun is correct it is improbable that echoes will be heard again before that time

CARL STØRMER

Oslo, Dec 12

[1] See The Norwegian Aurora Polaris Expedition, 1902–1903, vol. 1, Second Section, Fig 265A, p 712 (Longmans, Green and Co, London)

Soap Film Pressure Gauge

IF a soap film is formed across a circular aperture in one side of an otherwise closed box, and if then air is introduced into, or removed from the interior, the surface of the film becomes part of a sphere, and therefore the pressure within the box differs from that outside by a quantity which is directly proportional to the surface tension of the film, and inversely proportional to the radius of the sphere

If R r, and T are respectively the radius of the hole the radius of the sphere, and the constant of surface tension the difference of the air pressure inside and outside the box is $4T/r$ (since both surfaces of the film contribute to the tension) and the difference is + or − according as to whether air has been introduced or withdrawn

The radius of the sphere can never be less than R, and when $r = R$ the surface of the film is a hemisphere Thus $\pm 4T/R$ is the greatest difference of pressure which can be balanced by the surface tension

For any condition which makes the bubble less than a hemisphere, the film may be used as a pressure gauge, since the difference of pressure within and without the box can be determined if T is known and r measured There are several ways by which the radius of a bubble can be found, that which I have generally used being to measure the size of the virtual image, reflected by the film, of an object of known size and distance This allows of the determination of r with considerable accuracy

Convenient apparatus for the purpose can take many forms which need not be described here, but it is worth while to note the order of pressure difference which can be measured by soap films as compared with various other forms of barometric measurement A good barometer or aneroid will indicate the difference of level between the surface of the table and the floor on which it stands, say a head of 30 inches of air For a soap film, suppose, for example, that T has a value of 3 grains per linear inch and that $R = 1$ inch, then the maximum pressure difference which can be sustained by surface tension is 12 grains per square inch—equivalent to a head of about 3 feet of air Thus for this particular case the greatest pressure difference which can be dealt with by the soap film is not far from the minimum which can be observed by the aneroid With a soap bubble, however, the radius can without much trouble be determined with sufficient accuracy to allow of the measurement of pressure difference equivalent to heads of a few hundredths of an inch of air

I used this form of pressure gauge to find out whether, when a chimney smoked, the pressure in the room rose or fell A rise of pressure would show that the wind blew down the chimney and a fall that there was negative pressure on the lee side of the house In stormy weather I found many instances of both kinds, and the type which prevailed depended, as might be expected, on the direction of the wind

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Delayed Metamorphosis in a Predaceous Mosquito Larva and a Possible Practical Application

ON June 10 of this year, in a rot hole in a tree at Epe in Southern Nigeria, I secured a young specimen of the predaceous larva of the mosquito *Megarhinus* (*Toxorhynchites*) *brevipalpis*, Theo With the intention of bringing the insect alive to England it was retained in two or three ounces of its natural water and given a very restricted diet in the form of an occasional *Stegomyia* larva

It was eventually brought to England in the middle of August and was maintained at 24° C without any special attention, until it died on Nov 18 without having passed the larval stage

My reason for recording these observations is that it has been suggested (Buxton and Hopkins "Researches in Polynesia and Melanesia", London, 1927) that members of this predaceous genus of mosquito, which breed exclusively in rot holes, should be introduced into Fiji, Samoa, and other South Pacific islands as a measure of control of the local vector of filariasis (*Aedes* (*Stegomyia*) *variegatus*) which breeds in the same situation The nearest locality for *Megarhinus* in that part of the world is, however, the Bismarck Archipelago, and the difficulty and expense of establishing (as has been deemed necessary) intermediate stations in the conveyance of the insect from New Guinea to Queensland and thence to Fiji and Samoa—a distance of some 3000 miles—has prevented any attempt at the experiment

It now appears from the observation recorded above that by simply limiting the food supply the larval stage of this insect can be prolonged by at least five months, which would afford ample time for the transmission of larvæ direct, and thereby greatly facilitate the carrying out of the experiment in question

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Nitrogen Fixation the Growth of a New British Industry

THERE have always been those who delight in prophesying catastrophes to the human race, just as there have always been those who do not listen to them The future of mankind may, indeed, be violently affected by some un expected and extremely disconcerting cosmic disturbance, it is certain to be influenced in a less spectacular although equally impressive manner by limitations in the natural productivity of the earth's surface, and in the extent of the remaining reserve areas of virgin soil In a mere comparison of rates of productivity we appear to have ample material wherewith those so minded can, without much risk of contradiction, anticipate a first class human disaster, we also have an indication that the so called 'nitrogen problem' is not a transient condition, but a situation which in our own day needs courageous, systematic, and world wide measures for its solution We may assume that between a date which remains controversial and A D 1800 (perhaps half a million years, perhaps more) the population of this earth reached 800 millions of human beings, whilst from A D 1800 to 1900 it rose to 1730 millions, if this rate of increase continues—and there is no reason to anticipate the contrary—an early intersection of the population curve and the soil productivity curve is necessarily to be expected Indeed, it has been estimated that the present methods of farming will lead to a definite food scarcity before the end of the present century

However unpleasant an episode in the history of our race such an intersection might indicate, it would be more profitable to consider, while there is yet food enough and to spare and while any inadequacy of clothing is due to causes other than lack of raw materials, the alternative policies which are open to us We may be compelled to find a means of restricting the rate of increase of the population, or we may submit to restriction by starvation, we may even discover forms of food which are not agricultural in origin The obvious line of advance is, however, to seek to increase substantially the average output of the soil under cultivation This course involves not only a development of improved methods of farming, but also a cheaper and more abundant supply of inorganic fertilisers—particularly of suitable com pounds of nitrogen

Both of these matters are major problems with which the intelligent world finds itself confronted, and both are of dimensions which are scarcely amenable to parochial, even strictly national, treatment In the course of their development, for example, the primitive methods of cultivation in Eastern countries will gradually be replaced by more modern methods, in which the liberal, but always scientifically controlled, application of fertilisers not originating from previous agricultural operations will play their part in safeguarding the world's food supply and raising the standard of living It has been computed that in pursuance of this policy an annual addition of 125,000 tons of fixed nitrogen, that is, nitrogen in the form of suitable compounds, to the world's productive capacity is immediately necessary, and that in the future the amount will need to be larger

The nitrogen in the atmosphere cannot in general be assimilated by plants, although certain classes, particularly leguminous plants, are able with the assistance of appropriate bacteria associated with their roots to draw upon this enormous reserve of nitrogen, and thereby, in fact, to enrich the soil It will be remembered that in 1852, Lawes and Gilbert showed that non leguminous plants require for their growth a supply of nitrogenous compounds, and that the ammonia in the air, supposed by Liebig to be the source of the necessary nitrogen, was insufficient for the purpose, the stages in the investigations leading to Hellriegel and Wilfarth's discovery of the effect of bacterial action in the assimilation of atmospheric nitrogen by leguminous plants form a chapter of considerable interest Rothamsted, the home of Lawes and Gilbert's, and of a continuous succession of similar, experiments enjoys the distinction of laying a not inconsiderable part of the foundations of scientific farming and of the nitrogen industry, not only in Great Britain, but also throughout the world

In his address to the British Association in 1898, Sir William Crookes said "The fixation of atmospheric nitrogen is one of the great discoveries awaiting the ingenuity of chemists It is certainly deeply important in its practical bearings on the future welfare and happiness of the civilised races of mankind" Before 1914 the world's require ments of nitrate nitrogen were supplied from Chile, where immense deposits of sodium nitrate (associ ated with a small proportion of iodine in combina tion) were discovered only a hundred years ago Apart from similar nitre beds in Peru and Bolivia, all rainless districts, no other extensive deposits are known or anticipated to exist Exportation from Chile commenced about 1830, and by 1912 had reached more than two and a half million tons, representing 57 5 per cent of the total world's output of fixed nitrogen, 38 per cent was accounted for as by-product ammonium sulphate, originating from the illuminating gas and metallurgical coke industries Various estimates have been made of the probable life of the South American deposits, apart from considerations of economics, it is probable that they would be able to supply requirements for at least a century—a 'breathing space' but not a very long period in the normal life of an animal species

The agricultural prosperity of the British Empire has therefore been to an appreciable extent dependent on the goods exported by another nation, and this subjection the British chemical industry has the power, and the intention, to neutralise The existence of the British Empire was, not very long ago, dependent on its oppor tunity to purchase nitrate from Chile and its ability to transport the material to our own ports This three fold dependence is one which, it is to be

hoped, will never again exist The intention in this article is not to dwell on the place of the nitrogen industry in the defence of the British Empire, but it would be an affectation to ignore the undisputed fact that that position is vital God forbid that it should ever again be necessary for Great Britain to defend her shores with arms, but only while she can fix her own nitrogen has she the certainty of possessing the raw materials for her munitions So crucial, indeed, is the supply of fixed nitrogen in such an emergency, that voices have been raised against allowing the British industry to be under any control but that of the State, on the other hand, the record of State fixation of nitrogen in Great Britain is not such as to lend undue support to the contention

The methods which have been employed in solving what is commonly known as the 'nitrogen problem' are familiar Apart from the striking development of natural supplies already mentioned —supplies of by product ammonia being stationary, or even on the decline—methods based on the union of atmospheric nitrogen with oxygen or with hydrogen, either directly or indirectly, have been worked out on a laboratory scale, applied to a technical process, and have met with considerable, although naturally fluctuating, economic success The three most important processes are

(a) The arc process, in which nitrogen and oxygen are exposed to the very high temperature of an electric arc, whereby 1 15 per cent of nitric oxide is formed, this gas then being oxidised by air to nitrogen dioxide, which by reaction with water or alkaline liquids yields nitric acid, nitrites, and nitrates This process is losing ground on account of the high production costs and power requirements, and is manifestly unsuited for use in Great Britain, where cheap electrical energy is not available, in Norway, however, and elsewhere, it continues to be employed It has the advantage of employing free materials and a small amount of labour, and of producing nitric acid directly, on the other hand, the installation costs are high, and nitric acid is not a convenient product for transportation and agricultural use For this purpose calcium and ammonium nitrates are manufactured The credit of invention of the process, or rather of the successful technical adaptation of Lord Rayleigh's method for combining nitrogen with oxygen, belongs to Prof Birkeland of Christiania, and Dr Eyde, a Norwegian engineer, subsequent developments in furnace construction are associated with the names of Schonherr and of Pauling

(b) The cyanamide process, in which impure calcium carbide is exposed at a high temperature to the action of nitrogen, producing calcium cyanamide, $CaCN_2$, which when subjected to hydrolysis in an autoclave affords ammonia This process has been in use at Niagara since 1909, and is a familiar process elsewhere, it was the process chosen for use at the great war factory erected at Muscle Shoals, Alabama—a factory which cost twenty million pounds but never came into production Here again Great Britain suffers from the disadvantage of the high cost of electrical energy necessary for producing the carbide from lime and coke, and for heating it in contact with nitrogen, admittedly Great Britain (except in the Scottish Highlands) lacks adequate water power, but she has been slow to harness such natural power as is available

(c) Haber's catalytic process, in which a mixture of hydrogen and nitrogen under pressure is heated to a moderate temperature in chrome steel bombs in the presence of a suitable catalyst, such as pure iron mixed with small quantities of alkalis and acidic oxides, the ammonia so formed being removed by dissolution in water This process makes no extravagant power demands, and is suitable for development in Great Britain, for reasons which will appear later, it is, nevertheless, associated with technical difficulties of no mean order The hydrogen can be produced by the electrolysis of water, by the action of iron on steam, from water gas, or in the fermentation process for the production of acetone and butyl alcohol, the nitrogen can be obtained by fractionation of liquid air In the Bosch process the mixture of nitrogen and hydrogen is obtained from producer gas and water gas The famous German factories at Oppau and at Merseburg are devoted to the direct synthesis of ammonia Claude's modification of the process employs pressures of the order of 1000 atmospheres, and removes the ammonia by liquefaction

These three methods, as has been explained, form the backbone of nitrogen fixation as a technical operation subject to economic considerations Any process which produces ammonia is naturally to be combined with an oxidation process if—as is the case when munitions of war or intermediates for the chemical industries are concerned—it is desired to manufacture nitric acid This is accomplished by a catalytic method, generally known as Ostwald's method, in which a mixture of gaseous ammonia with air or oxygen is passed over heated platinum, whereby nitric oxide, afterwards oxidised by the further action of air or oxygen to nitrogen dioxide, is obtained On dissolution in water under oxidising conditions, this gas affords nitric acid Numerous variations in the arrangement of the catalytic converter have been worked out and employed in Great Britain and elsewhere Incidentally, it has been found that the catalytic oxidation process can be profitably applied to the production of nitrogen oxides in the lead chamber process for manufacturing sulphuric acid, indeed a British report on the subject was issued so early as 1917

Passing reference may also be made to other and less successful processes for the fixation of nitrogen The Serpek process is based on the production of aluminium nitride when nitrogen is passed over a mixture of carbon and impure aluminium oxide, the reaction may be carried out under pressure On hydrolysis of the product with sodium hydroxide solution in an autoclave, ammonia and sodium aluminate solution result, the latter affording pure alumina (suitable for the manufacture of aluminium) on treatment with carbon dioxide In Bucher's process, nitrogen is passed through a mixture of sodium carbonate and carbon, together

with a little finely divided iron as catalyst, heated at about 950°, when sodium cyanide and carbon monoxide are produced, the sodium cyanide is then decomposed by steam yielding sodium formate and ammonia. Partington and Parker ("The Nitrogen Industry," 1922) state that the United States Government made careful investigations of this process, and that a large plant was said to be ready to begin operations in 1918.

However, the direct catalytic synthesis of ammonia is probably to be regarded as providing the key to the world problem of nitrogen supplies. The atmosphere contains enough—some 4×10^{15} tons, it is said—and to spare; Haber's process makes no excessive demands as regards power or fuel, and it now holds a pre-eminent position in the field of nitrogen fixation. In view of its proved success and its established position in Germany under conditions both of war and of peace—manufacture there having been proceeding since 1913, and production in Germany to-day being of the order of 600 000 tons per annum of nitrogen—it is not surprising that in the development of the nitrogen fixation industry, which continues to extend rapidly in most European countries, as well as in the United States of America and in Japan, new plants should envisage the application of this process almost exclusively. The advantages which direct synthesis of ammonia offers are, in fact, such as to introduce the method into Norway, the home of the arc process.

(*To be continued.*)

The Skull of Lord Darnley[1]

IN the year 1869 Mr. J. W. Belt presented to the Royal College of Surgeons a skull—minus a mandible—and a thigh bone, believed by the donor to be those of Lord Darnley. He had obtained them from Mr. Grimshaw, a dealer, who had bought them four years earlier at a sale by Messrs. Sotheby and Co. of certain effects belonging to the Hon. Archibald Fraser of Lovat. The Conservator of the Museum, looking the gift horse in the mouth, entered the bones in the Museum catalogue, with the remark that "the internal evidence afforded by both bones conclusively negatives their authenticity. Darnley at the time of his death in 1567 was about 22 years old, and the bones are those of a man considerably more advanced in life and of great muscular development. The almost complete absence of frontal elevation, which is one of the most striking features in the skull, finds no corroboration in any of the known portraits and descriptions of the young Earl, and the femur could not be that of a person invariably described as 'tall' or 'long,' as calculating at the usual ratio of 27.5 to 100 it would give a height of only 5 feet 2.2 inches." So adverse a decision would be sufficient to deter most from further inquiry, but not Prof. Karl Pearson, who has attempted, with what success we shall see, to establish the authenticity of the more important of the relics, namely, the skull.

In 1880 Mr. T. M. Grimshaw—presumably the same man from whom Mr. Belt obtained the bones mentioned above—offered the Conservator of the Museum of the Royal College of Surgeons a femur bearing a manuscript label to the effect that it was "the thigh bone of Lord Darnley, husband of Mary Queen of Scots, murdered and blown up, February 10th, 1567." This, he stated, had been bought at a sale at Sotheby and Wilkinson's, together with two other bones, 'the thigh bone of Little John, the companion of Robin Hood, and the shin bone of Humphrey, Duke of Gloster"; no mention is given of the date of this sale. The femur was purchased and entered in the Museum catalogue as "that of a very tall man, probably the real thigh bone belonging to the skull," presented eleven years earlier by Mr. Belt, an assumption which is almost certainly correct, for skull and femur exhibit the same peculiar coloration, "such as usually obtains," to quote the new catalogue, "in bones that have lain long in a peat bed."

If we accept, as we think we safely may, the single origin of the two relics, namely, the skull presented in 1869, and the femur purchased in 1880, then clearly, from the point of view of authenticity, they must stand or fall together. The authenticity of the femur gains support from the manuscript label, but suffers from the strange company in which the bone appears, company for which Prof. Pearson has no use, dismissing them summarily as 'bones of most absurd attribution." In this we think Prof. Pearson has done wrong, for a little inquiry would have shown that the bones might very well be those of the more or less venerable Englishmen to whom they were ascribed. 'Little John'—or such part of him as was not apocryphal—was a big, stalwart man, whose grave is still to be seen in Hathersage churchyard. The grave was rifled, we are told, in 1782, and again in the early years of last century, when a thigh bone, measuring, it is said, 32 inches, was taken from it.[2]

Humphrey, Duke of Gloucester, murdered at Bury St. Edmunds, was buried in St. Albans Cathedral. The leaden coffin containing his body, and 'full of pickle," was opened in the reign of Queen Anne; the body was taken out of the preserving fluid, and "reduced to a skeleton, the smaller bones of which the vergers permitted visitors, for a due consideration, to carry away."[3] If, then, the two bones can scarcely be described as Daniels come to judgment, they are nevertheless not the guys which at first sight they appeared. They further serve the useful purpose of restoring our confidence in the good faith of Sotheby and Grimshaw, a not unimportant matter, seeing that they are among the sponsors for the relics. Sir Arthur Keith[4] thinks it "most probable" that

[1] *Biometrika: a Journal for the Statistical Study of Biological Problems.* Edited by Karl Pearson, assisted by Egon S. Pearson. Vol. 20 B, Part 1, July. Pp. 104+46 plates. (London: Biometric Laboratory, University College, 1928.) 21s. 6d. net.

[2] Guide to Buxton, the Peak, Dovedale, etc. (London: Ward, Lock and Co.)

[3] Saint Albans. (Bell's Cathedral Series.)

[4] *British Medical Journal*, Sept. 8, 1928.

the femur presented by Mr Belt with Darnley's skull was the femur of 'Little John' This can scarcely be, but, granted a certain confusion, and such appears to have occurred, and was not unlikely in a saleroom, where such objects as bones can be so easily mislaid, forgotten, and wrongly ascribed, it is not impossible that the femur in question is that of Humphrey, a man of no little importance in his day, own brother as he was of Harry of England

It is now time to record certain strange events which followed on the death of Darnley His body, blown up by the explosion at Kirk o' Field on the morning of Feb 10, 1567, was bowelled and embalmed with perfumes and spices, and four days later buried in the Royal Vault in the south east corner of the Abbey Church at Holyrood There the body lay in undisturbed privacy until January 1683, when, in the removal of certain seats, the Royal Vault was discovered and found to contain six leaden coffins Of these, two contained the bodies of children, the infant sons of James V, three bore on them, or near them, inscriptions indicating that they contained the bodies of James V, his first Queen, Magdalen, and his illegitimate daughter, the Countess of Argyll James's body was coloured black with the balsam which preserved it, which was like melted pitch The sixth and largest coffin contained a body not so long as that of James V, with the muscles of the thigh seemingly entire, and with balsam stagnating in some quantity at the foot of the coffin it bore no inscription, but it was generally and confidently supposed to be that of Lord Darnley

In 1688 the 'Glencairn purging' included the violation of the Royal Vault, but apparently the bodies were left more or less intact, for in 1735—incredible though it seems—they were seen "lying open to the view," the coffins having been broken into by the mob in 1688 Still later, in 1776, they were seen by Arnot, "the head of Queen Magdalen being entire and even beautiful" In 1778 the same antiquary reports that both the Queen's head and Darnley's skull had vanished It will be noticed that references are to Darnley's skull, not to his head, from which we may presume that the embalming, always "an hazardable piece of art," had not been so successful in his case as in that of Queen Magdalen No mention is made of the colour of his skull, but it seems not unreasonable to assume that it was like that of James V, black

We next hear of the skull through Alexander Campbell, who wrote that it "is preserved among the curiosities of the Antiquarian Society of Scotland, exhibiting melancholy proof of the effects of his incontinence"—a significant remark, for it implies that some part or parts of the skull had been eaten away, the popular and not unscientific conception of the effects of syphilis, and further explains the relative ease and confidence with which the relic was followed in its subsequent wanderings In spite of Campbell's statement, no mention of the skull has been found in any of the catalogues of the Scottish Society of Antiquarians, an omission attributed with some reason to its being the personal property of James Cummyng, the secretary of the Society, who would naturally hesitate to make it publicly known that he was in possession of so important a relic, obviously nefariously acquired At his death it is believed it was sold by his executors with other of his effects, passed into the hands of an Edinburgh sculptor, and finally into those of Archibald Fraser of Lovat No mention, it will be noted, is made of the thigh bone until it appeared with the skull in Sotheby's catalogue

Such, then, is the historical evidence—not, it is true, absolutely convincing, and yet not, we think, to be lightly set aside in view of the general and confident identification of the body in the large coffin, of the early recognition of distinctive marks on the skull, and of the reputation of the various witnesses The chain of evidence is complete, but not all the links are strong

We now pass to a consideration of the actual relics, for confirmatory or rebutting evidence First, as regards their colour this varies from a light brown to a blue black Dr H A Harris, in a recent article,[5] attributes both the colour and the polish, here and there apparent, to the bones having been painted with shellac Prof Pearson attributes them to the body having been embalmed, to the "stagnating balsam" to which reference has already been made The question cannot, we infer, be decided by the chemist, as both shellac and balsam are resinous substances Of the two explanations, we are inclined to accept that of Prof Pearson The extreme variations in colour, thickness, polish,—the patchy distribution are all against the coating being due to the undiscriminating 'dead' hand of man working with a uniform medium, and in favour of the more or less natural 'wash' of a solution of varying composition, picking out for different treatment different anatomical areas We would particularly instance the appearance of the posterior surface of the neck of the femur, there being a sharp distinction between the colour and patina of the upper and lower parts, the line of separation agreeing exactly with the line of attachment of the capsule of the joint It is difficult, again, to explain on Dr Harris's hypothesis why the interior of the cranium is similarly coloured to the exterior

If, then, we are inclined to accept Prof Pearson's explanation, we might hope to find some evidence of embalming, in clinging remains of soft tissues these we find in the interior of the cranium, for not only is part of the general dura mater still evident, but we can actually see on the left side of the mid line the lacunæ laterales stretching from frontal to occipital region—a piece of evidence not available to Prof Pearson when he wrote his monograph, for at that time the skull had not been opened That the skull was never buried in the usual way is almost certain Sir Arthur Keith has shown that there is an entire absence of earth in any of the natural cavities, such as the cranial cavity, external auditory meatus, tympanum, sphenoidal sinus It may, however, be argued that

[5] *British Medical Journal*, Sept. 15, 1928.

the skull was that of a criminal whose body had been handed over to an anatomical department This might be so, but in such case we should expect the calvaria to have been removed, and the bones, if kept, completely macerated The evidence for the belief that the skull and femur are from an embalmed body is, in our opinion, strong The description of the appearance of the body of James V, and the statement that Humphrey's coffin was full of pickle, will convey some idea as to what the results of embalming in certain circumstances might be

We now come to the strangest of all the features of the skull, the presence of a large number of more or less circular pits on the vault—" the melancholy proof of the effects of his incontinence," to quote again Alexander Campbell These, by many, if not by most, have been attributed to syphilis, and Prof Pearson is at great pains to prove that Darnley suffered from this complaint, which, presumably, had reached the tertiary stage at the time of his death We do not propose to enter into the arguments for this opinion, for we are convinced that the pits are not due to disease, the complete absence of all signs of inflammatory reaction, as both Dr Harris and Sir Arthur Keith have pointed out, definitely negativing such a theory If, then, as Prof Pearson asks, they are not due to syphilis, to what are they due ? Dr Harris confidently dismisses them as artefacts made with some such instrument as a bradawl He gives no reason for so singular a procedure on the part of an 'unknown,' but no doubt the idea of faking evidence might be advanced Dr Harris's theory leaves unexplained the inequality in the size of the pits, the singular manner in which they are grouped, and their confinement to, practically, one side

Our own theory of the pits is that they are due to the action of some burrowing insect We arrive at this partly because, excluding the two theories already mentioned, little else remains, partly because it is well known that an extensive fauna preys upon the bodies of the dead, but mainly because of certain positive reasons A close scrutiny of the pits will show that their circumferences not infrequently intersect, that the pits often occur in pairs, that at times part of the circumference shelves, giving a pyriform outline to the pit, at times a shallow groove leads from one pit to another, producing a dumb-bell appearance Such features are, we consider, in keeping with what we know of the action of burrowing larvæ, which, when they meet anything uncongenial, are in the habit of moving a little aside and then proceed to burrow afresh The varying size and shape, the number, arrangement, and distribution of the pits, all lend support to such an explanation Can we obtain any corroboration ?

Sir Arthur Keith, when in Glasgow lately, observed certain skulls somewhat similarly pitted two of these have now been lent by Prof Bryce to the Royal College of Surgeons, where we have had an opportunity of examining them They are from a medieval graveyard at Crosschurch, Peebles Although the pits on these skulls are not so numerous or so cleanly cut as those on the 'Darnley' skull, they are, in our opinion, essentially of the same character Further, near a pit on one of the skulls we have noticed a collection of what appears to be bone debris and earth, stuck to the skull possibly through admixture with some animal excretion, reminding us forcibly of the description by Prof Elliot Smith of the collections left by beetles on Egyptian skulls[6] Prof Elliot Smith, however, is insistent on the fact that beetles only attack skulls which have been buried, a restriction with which of course the Crosschurch skulls conform, but not, if we are correct in our 'embalming' theory, Darnley's Our ignorance, however, of the conditions within the large lead coffin both before and after the contents were exposed is such as to prevent us from offering any opinion as to whether they were more or less favourable to insect life The pits do not appear to us to have any significant bearing on the question of the authenticity of the skull

We have now to consider the form of the bones, and finally the age of the individual to whom they belonged The femur clearly is that of a tall, spare individual of no marked muscular development We are fortunate in knowing what Darnley's legs were like, for we have an admirable full length portrait of him, aged seventeen, in doublet and hose, by Hans Eworth Although, admittedly, there is little individuality in legs, those of the portrait are exactly those which we should expect the owner of the 'Darnley' femur to possess

As to the skull, we fail to find those signs of great muscular development to which the Conservator of the Royal College of Surgeons in 1867—Sir William Flower—refers We venture to think that if the skull were macerated and bleached, it would in a large measure lose such indications of muscular development as it may be thought to show The outstanding feature of the skull is, however, as Sir William Flower pointed out, the absence of frontal elevation Of this, it will be remembered, he found no corroboration in any of Darnley's portraits, on the other hand, we find no certain refutation In considering this question we must remember that portraits in early life are misleading, for then the skull is naturally of a different shape from that which it ultimately attains, and in no region, unless it be in that of the jaws, is the difference greater than in the frontal region All the portraits on canvas which we possess of Darnley are full face, and hence any absence of frontal elevation is, or may be, relatively unapparent The so called Cenotaph portrait was painted some time after death, and is, for reasons which Prof Pearson makes plain, entirely untrustworthy There are, however, two portraits on medals commemorating the marriage of Darnley and Mary—a third is apparently a copy of one of the others—which show Darnley in profile They are too crude to justify any confident expression of opinion, but they go some way towards corroborating the authenticity of the skull By the use of Coradi's

[6] *Lancet*, 1908

pantograph, Prof Pearson has superimposed skull on portrait, and brought out still more clearly the resemblance We agree, too, with Prof Pearson in finding more than a hint of a low, retreating forehead in the important full face portrait belonging to the Duke of Devonshire, masked though it be by 'cap and hair' On the whole, we consider the evidence of the portraits not antagonistic to the claim of authenticity

We now come to the most critical of all the questions, for clearly, if it can be definitely shown that the bones are not compatible with their being those of a man of Darnley's age, $21\frac{4}{12}$ years, then the whole of the argument falls to the ground To answer such a question we naturally turn to the epiphyseal lines of the femur, the spheno-occipital joint, the sutures of the cranium, and to the teeth —although all these last are missing, the empty sockets are available We may say at once that an examination of these parts by the unaided eye gives no justification for denying the authenticity of the bones Dr Harris, who has paid much attention to these matters, studying them, moreover, with the aid of X rays, thinks otherwise, and puts the age of the individual to whom the bones belonged at not less than twenty five He confirms his view by reference to the size of the diploic veins Even if we accept, as with certain reservations we are disposed to do, Dr Harris's generalisations, we would point out that the range of variation in all departments of human anatomy is wide, and nowhere perhaps wider than in such matters as those under consideration, and that in these circumstances we must allow a corresponding latitude in judgment Nor, we would add, are the results of X ray photography as a rule only open to one reading and interpretation

A review of the evidence, historical and anatomical, leaves us no option, we think, but to conclude that, while certainty is denied, there is very strong probability that the relics considered, once formed part of that young, proud prince who caught the eye and won—if only for a season—the heart of perhaps the most romantic figure of modern times —" red star of boyhood's fiery thought "

Although this is neither the time nor the place to enter into considerations of Mary's character and of the part she played in Darnley's murder, we cannot conclude without paying high tribute to the learning and eloquence of the latest of her apologists We remain, however, unconvinced "Has he shown," as David Hume was in the habit of asking, 'that she didn't marry Bothwell?" Alternatively, what of Chastelard? It was her participation, active or passive, in the two tragedies of Darnley and Chastelard, which more than all else was responsible for the bitter and almost universal hatred of two great nations, neither notably lacking in generosity and sentiment, and which drove her, a fugitive queen, to seek refuge in a foreign land WILLIAM WRIGHT

News and Views

IN continuation of a practice that NATURE has pursued for the past four years, there is printed elsewhere in this issue the first instalment of a new calendar, which will be devoted to items of importance and interest from the records of British and other patents for inventions No apology is needed to our readers for the choice of this subject, for it will be fully realised that the literature of patents (which now includes amongst a mass of other material upwards of four million separate specifications of inventions from all countries) forms a survey of the industrial progress of the world from the seventeenth century onwards that stands unrivalled Not much of this literature, of course, is concerned with epoch marking inventions, but a great deal of it refers to lesser known patents which have had no little influence on subsequent developments Some of these have made their contribution direct, whilst others, though not themselves put into practical use, have yet stimulated later inventors, and have often formed the basis on which the final success has been achieved, others, again, have had their day and (perhaps only for a time) have passed into oblivion It is with this class rather than with the well known inventions that the calendar is intended mainly to deal, whilst it is felt also that a few notes should be included on some of those fruitless and extravagant ideas that are scattered through the records and have resulted in nothing but the shattering of life long ambitions Of necessity, the bulk of the material will be taken from British records, since these cover a longer period of time than any others, and are for the most part more easily accessible, but foreign dates of interest will also be included from time to time

No part of Africa suffered more from the War than the Mandated Territory of Tanganyika, which comprises most of what was formerly German East Africa From practically the beginning to the end it was a scene of conflict, with consequent breakdown of the administrative services, dislocation of its communications, interference with the normal occupations of the native inhabitants and the destruction of lives, their villages, crops, and domestic livestock The task of repairing the havoc had to be undertaken by British officials who replaced the deported Germans Most of these British officials were unfamiliar with the country and its peoples They deserve the greatest credit, therefore, for the way they have coped with the difficulties of their situation Their success can best be measured in terms of the trade of the country The present exports and imports show a marked increase on those of pre War years New varieties of crops have been introduced, and the cattle industry is in a flourishing condition The education and other social services have been greatly extended Hundreds of miles of new railways have been constructed

IN September next, under the presidency of the governor, Sir Donald Cameron, Tanganyika is to hold its first Agricultural and Industrial Exhibition,

which is intended to be representative of the varied agricultural products grown by the native and European farmers, of the cattle industry, the country's forest resources, and its mineral wealth—the development of which is still in its infancy. At the same time, it is expected that machinery manufacturers will instal actual working exhibits of the plant and machinery used in the cultivation and preparation of such crops as sisal, cotton, coffee, oil seeds, tobacco, tea, rice, and other grains. It is hoped that the exhibition will be well attended by representatives of trading and manufacturing concerns in Great Britain. Those members of the British Association who are visiting East Africa after the South Africa meeting would probably find it interesting to break their journey at Dar es Salaam to visit the exhibition.

AUSTRALIA has large tracts of land with a soil and climate well adapted for dairying and beef production. These fertile areas have, however, not yet been fully developed and are very sparsely populated. If this Dominion is to maintain its 'all white' policy, it is necessary that the settlement of these lands should be accelerated. The best means of accelerating the settlement is by increasing the prosperity of primary industries based on the land. During the present year, at the invitation of the Australian Government, Sir Arnold Theiler, formerly director of the Veterinary Research Station at Onderstepoort, South Africa, and Dr J. B. Orr, director of the Rowett Institute, Aberdeen, visited Australia to meet the executive of the Council of Scientific and Industrial Research, and research workers, to discuss the organisation and extension of research in animal health and animal nutrition.

DR. ORR was able to stay in Australia for only a few weeks, but Sir Arnold Theiler made an extended tour of six months' duration, during which he was able to make observations on some of the common animal diseases in Australia and offer valuable suggestions with regard to the efforts being made for their elimination. Both of these authorities have submitted reports with recommendations for the development of research in their respective subjects. The reports emphasise the value of the work already being done in Australia, but agree that there is still a vast field for applied science, and that the co-ordination and extension of research effort is likely to yield economic results through the decrease of disease and the increase of production. It is understood that the Council for Scientific and Industrial Research has decided to undertake an extensive research scheme on a Commonwealth basis, and that work under the scheme is likely to be begun in the immediate future.

THE function of a telephone circuit is to convey ideas from one person to another, and hence a measure of the efficiency of the circuit is the ratio of the number of ideas transmitted to the total number of ideas sent over the circuit. The value of this fraction is called the 'intelligibility' of the circuit. Its value is obtained by speaking a number of sentences, so designed that each conveys a single intelligible idea, into the microphone, and a listener at the telephone recording what he thinks he has heard. An example of a sentence used is 'The man hit the big dog.' The method is laborious, since a large number of such sentences must be spoken before a trustworthy average can be obtained. This and similar problems are ably discussed in a paper by Mr. John Collard, entitled "A Theoretical Study of the Articulation and Intelligibility of a Telephone Circuit," published by the International Standard Electric Corporation, of Connaught House, Aldwych, London. Mr. Collard points out that from the subscriber's point of view the efficiency of a telephone circuit should be judged by the relative time required to convey a given number of ideas over the circuit. For this purpose a quantity called the 'time efficiency' is defined. It is the ratio of the time required to transmit a given number of ideas over an ideal circuit to the time required to transmit the same ideas over the given circuit.

MANY other quantities are considered by Mr. Collard in his paper, as, for example, the 'syllable articulation' obtained by speaking a number of random syllables into the circuit. The results obtained are wonderfully constant, and the author develops a theory which gives algebraical relations between the various quantities. When a telephone circuit passes through different countries, it is usual to standardise the language of one of the countries as the operating language. So far as 'intelligibility' goes, the Italian language is the best, and next come German, English, and French. The actual time, however, to transmit a given number of ideas over a telephone circuit is least for French, and then come English, German, and Italian. It is best, therefore, to use a language like French or English. It is quicker to speak a language of short words, even when some of the sentences have to be repeated owing to the low intelligibility, than to speak a language of long words which has a relatively high intelligibility.

MANY reasons are given to explain why so many countries in Europe have electrified their main railway lines. Two of the most popular reasons given are either that they desire to be independent of foreign coal supply or that, as in Switzerland, they desire to make use of their waterfalls. Neither of these explanations has anything to do with the electrification of the main railway connecting Rotterdam and Amsterdam, two of the most important towns in Holland. In this case it was simply that the continually increasing volume of traffic made it difficult for steam locomotives to work the line satisfactorily. Although the section from Rotterdam to the Hague had been operated by single phase current since 1908, it was decided a few years ago to adopt direct current at 1500 volts, which is now the standard system in England and France. A description of the substations and rectifier apparatus for converting the a.c. generated into d.c. for the locomotives on the Dutch railway is given in the *Brown Boveri Review* for December. This is the first time that fully automatic rectifier substations have been employed in Europe for a main line railway. From the data given in this paper we learn that mercury arc rectifiers enclosed in steel cylinders are being widely

used for converting alternating current into direct current for traction purposes As compared with rotary converters this method has advantages The efficiency of the converters is more than 95 per cent, the yearly cost of maintenance is small, and an appreciable saving in labour is effected by their use These high power rectifiers seem particularly adapted for traction work and have been working satisfactorily for several years The New South Wales Government will soon have ten 1500 kilowatt automatic rectifier equipments on its railways and tramways

The catalogue of spectrometric apparatus which has just been issued by Messrs Bellingham and Stanley, Ltd contains particulars of new apparatus One of the most interesting instruments is a small quartz spectrograph of the Littrow type, which is supplied at the low figure of £18, 10*s* Unfortunately, the dispersion given by the instrument is not stated, but it is recommended for chemical analysis, particularly for quantitative work, depending on relative intensities of lines, and for the examination of many of the non ferrous metals Another quartz spectrograph, of entirely new design, is arranged so that the slit and photographic plate are horizontal This facilitates observation of the spectrum, particularly for the study of fluorescence, and permits greater rigidity than the ordinary arrangement A dispersion of 130 mm between the wave lengths 6000 and 2100 A is produced, and the price of the spectrograph is £65 Another useful instrument designed for the examination of the spectra of feeble sources of light in the visible region, is a glass spectrograph of the ordinary type, of which the lenses have an effective aperture of F/2 and a focal length of 5½ in It is specially recommended for the study of fluorescence, spark spectra and neon stroboscopic photography The cost is £190 For the comparison of spectra taken on different plates a simple spectro comparator has been designed at £17, 10*s*, with an additional charge of £6 5*s* for optional accessories It is specially intended to facilitate chemical analysis, and is recommended in particular for determining the exactness or otherwise of apparent coincidences of spectrum lines when high dispersion is not available Several other instruments also are described in the catalogue Messrs Bellingham and Stanley's work is known to reach a high standard of excellence, and their instruments may be depended upon to do all that is claimed for them

Dispatches in the *Times* of Dec 22 and 27 from Sir Hubert Wilkins and his pilot, Lieut C B Eielson, announce important discoveries in the Antarctic The expedition had been waiting at Deception Island for some weeks for favourable conditions for the aerial survey work which is planned, and it was not until Dec 19 that Sir Hubert and Lieut Eielson were able to set out in their Lockheed monoplane They made a flight of about 1200 miles, during which they found that Graham Land is an island separated from the Antarctic continent by an ice filled channel, and discovered six hitherto uncharted islands Taking a southerly course from Deception Island across the Bransfield Straits, they reached Graham Land, an ice shelf appears to cut Graham Land in half, the northern portion being a table land while the southern half is more irregular, with mountains rising to 8000 9000 ft , the coast line is much indented About Lat 70° 71°, Long 60° 70° is apparently low lying land, mostly snow covered, and immediately to the south is a strait 40 50 miles in width Beyond this strait is the ice cliff bordering the Weddell Sea At this point the monoplane was turned back and reached Deception Island safely, having been nine hours in the air Sir Hubert Wilkins is to be congratulated on the good beginning to his projected survey of the coast line of the Antarctic continent

The curtain was finally rung down upon the Glasgow meeting of the British Association on Wednesday, Dec 19, at a meeting held in the City Chambers, Glasgow, when final reports were received the actions of the various committees approved, and the local executive committee discharged Various speakers including the Lord Provost, who presided, and Principal Sir Donald MacAlister, gave expression to the widespread feeling of gratification that the citizens of Glasgow had done their part so well in making the meeting a success Attention was directed to the fact that, thanks to the skilful administration of the honorary treasurer Sir John Samuel, the finance committee was in a position to make a return of five shillings in the pound to subscribers to the guarantee fund Cordial votes of thanks were accorded to the Lord Provost, Sir Donald MacAlister, and others who as officials or members of committees had contributed to the success of the meeting, and more than one speaker emphasised in particular the immense debt due to the administrative genius accompanied by unstinted labour, of Sir John Samuel who filled the office of acting secretary in addition to that of honorary treasurer

On Dec 20, Mr J Swinburne gave a historical account of the invention and development of the Swan carbon incandescent lamp to the Institution of Electrical Engineers This lamp was first shown in public at Newcastle on Tyne on Dec 18 1878, fifty years ago The invention of a platinum iridium lamp by Staite in 1845 first directed Swan s attention to the possibilities of an incandescent lamp He carbonised narrow strips of paper and lighted some of them with a battery of 50 cells, but they soon burned out This was between 1855 and 1860 A few years later, the Sprengel pump was invented and electric lighting became a possibility Swan then associated with C H Stearn an enthusiast in high vacuum work When a straight carbon conductor was used, variations in its length and local heating at points on the filament caused great difficulties Swan s first good results were obtained with thin straight carbon rods These lamps were exhibited in 1878 In 1880 he found that he got better carbons by using parchmentised paper, such as is made for covering jam jars Good results were obtained by treating knitting cotton with sulphuric acid of suitable strength and washing and drying it In 1884–85, Swan, assisted by Stearn and Topham, worked out the squirting process, using pyroxylin and reducing it Other makers then

adopted other solutions in a similar way Hence Swan, working almost independently, developed and produced the carbon incandescent lamp which was almost universally used until the advent of the tungsten filament

THE Society for Experimental Biology held a conference at University College, London, on Dec 14 and 15 Among many interesting papers, Dr R K Cannan gave an account of modern views of oxidation systems in the cell, Miss A M Copping and Prof J C Drummond reviewed the controversy as to the necessity of 'bios' for yeast growth, and showed that the disagreement between various workers is attributable to variations in different yeast species employed Dr H A Harris gave an analysis of the conditions required for proliferation on one hand, and differentiation on the other, in the development of tissues During the third session a series of papers on the relation of anterior pituitary to sterility and on the nature of pseudopregnancy were followed by an excellent discussion led by Dr B P Wiesner and Dr A S Parkes In the second session many demonstrations were given, Prof J Brontë Gatenby and his colleagues showed a beautiful demonstration of Golgi bodies, vacuome and mitochondria stained *intra vitam*, and Dr E Bozler gave convincing illustrations of his interpretation of muscle structure in various phyla of the animal kingdom

WE much regret to announce the death, which occurred on Dec 23, of Sir William Thiselton Dyer, K C M G, C I E, formerly Director of the Royal Botanic Gardens, Kew, at the age of eighty five years

THE triennial award of the Coopers Hill War Memorial prize and medal, which fell in 1928 to the Institution of Electrical Engineers, has been made by the Council to Mr W Phoenix for his paper on "Electricity in Agriculture, with special reference to Electro Culture"

A NEW publication, entitled "Civil Aeronautics," compiled by the office of the Legislative Counsel, United States Senate, has been issued by the Government Printing Office, Washington, D C It contains 178 pages, full of valuable information regarding the legislative regulation of civil aeronautics It contains the text of the Air Commerce Act of the United States, of 1926, and material relating to the legislative history of that act, including committee reports, and a comparison of the bills as passed by the Senate and by the House, extracts from reports and articles on the legal problems of civil aeronautics, including publications of the American Bar Association and the Conference of Commissioners on Uniform State Laws, extracts from reports on legislation on civil aeronautics of the States of the United States, including decisions of State courts, and the text of international agreements relating to civil air navigation The entire field of the legislative regulation of civil aeronautics is covered comprehensively right up to Aug 1, 1928 Among the valuable articles included in it are several reports prepared by the Committee on Air Law of the American Bar Association Copies of this publication may be purchased from the Superintendent of Documents, Government Printing Office, Washington, D C

Our Astronomical Column

THE COOKSON FLOATING ZENITH TELESCOPE — This instrument was designed by the late Mr Bryan Cookson, and presented at his death to the University of Cambridge Observatory, it was in use there for two years, and was lent in 1911 to the Royal Observatory, Greenwich, where it has been in use from 1911 to the present time The observations are discussed in periods of seven or eight years, in order to separate the annual term from the 14 month term in the variation of latitude The discussion of the observations of the second period (1919–1927) has just been published by the Royal Observatory in a small volume of 67 pages

The Talcott method of observing pairs of stars at equal distances north and south of the zenith is employed The trails of the stars are recorded photographically The telescope is floated through 180° in its circular trough of mercury between the exposures

The final value for the aberration constant from the whole period 1911–1927 is 20 445″ ± 0 009″ The second period (1919–1927) gave a value 0 005″ greater than the first (1911–1918) Taking the velocity of light as 299797 km /sec (Mt Wilson, 1926–1927) and the equatorial radius of the earth as 6378 355 km, the resulting solar parallax is 8 815″ ± 0 004″

A plate shows graphically the variations of latitude for the fifteen years 1912–1927, the results of the international latitude stations are shown for comparison. On the whole, the agreement between them is very good The chief differences are in 1916, where the Greenwich maximum is distinctly higher than the other, and in 1919, where Greenwich shows an abnormal minimum that is only faintly hinted at in the international curve

VARIATION IN LIGHT OF POLARIS —This star was for some time taken as a standard in stellar photometry, which makes the accurate determination of the period and amount of its light change of special importance *Bulletin of Astron Institute of the Netherlands*, vol 4, No 160, contains a discussion of it by A de Sitter He uses seventy eight pairs of plates taken at Leyden by N W Doorn between July 1925 and July 1928, he combines the results with those of eight other determinations, extending back to 1879, and obtains the period 3 968148 days ± 0 000055 The variation is analysed as a simple sine curve, which appears to give a sufficiently good representation

DIMENSIONS OF THE PLANETS —W Rabe gives an exhaustive discussion in *Astr Nach*, No 5601, of the most probable values of the diameters of the planets He collected all the most trustworthy measures, in which he included some recent ones of his own Taking the solar parallax as 8 80″, he finds the following diameters in kilometres Mercury 5140, Venus 12,620, earth (equatorial) 12,756, Mars (equatorial) 6860, (polar) 6820, Jupiter (equatorial) 143,600, (polar) 134,800, Saturn (equatorial) 120,600, (polar) 109,000, Uranus 53,400, Neptune 49,700 Outer diameter of Saturn's ring 278,500, inner diameter of crepe ring 144,000

Research Items

LIONS IN EUROPE.—It is known that lions inhabited Europe in historical times, the fact is mentioned by both Herodotus and Aristotle. Herodotus (480 B.C.) even determines the area in Macedonia inhabited by lions, and recounts that during the march of Xerxes through Macedonia, lions attacked and destroyed the Persian carrying camels. Aristotle (384–322) speaks of the same area, but mentions that lions are rare there. There are no later indications of their occurrence. Some investigators (O. Keller) do not attribute much value to this ancient information, supposing the group of lions to have been brought by Persians during their previous campaigns, which had lingered for more than a hundred years in the wild mountains of Macedonia, whilst the majority holds that the Macedonian lions were the last of lions, spread throughout Europe during the Pleistocene age, which later, under the oppression of man and deteriorating conditions of life, trekked south. Whatever may have happened, the existence of lions in Europe in historical times is not affirmed by any palæontological discoveries, and in this sense the discovery to which we are referring is unique. V. Gromova, in *Priroda* No. 10, mentions that among the rich palæontological materials collected by the Russian Academy of History of Material Culture between the years of 1901–1927, in the district of the rich ancient Greek city Olvia in S.W. Russia, a piece of the upper jaw of a lion, together with the upper canine tooth, was found. The tooth differs greatly from the canine tooth of a tiger by its shape, and from that of the other members of the cat family by its large size. However, as there was only one such discovery, its explanation should be approached with great care. It is quite probable that the lion was brought from Asia Minor, where the existence of lions, even up to the Mediterranean, in ancient times, is confirmed by a series of literary notes and discoveries of bones. It is well known (O. Keller, "Die Antike Tierwelt," pp. 29-31) that people of distinction and their wives kept lions as domestic pets, which accompanied them during walks, campaigns, etc. Above all, lions played a prominent part in the circus fights. It is quite probable that such is the origin of the Olvian lion; moreover, the solitary tooth is of the small size, such as is found in lions kept in zoological gardens only, and probably denotes a sign of degeneration. Thus the palæo-zoographical value of the discovery remains doubtful.

FRESH-WATER EELS OF NEW ZEALAND AND AUSTRALIA.—In the course of his work on the fresh-water eels of the genus *Anguilla* throughout the world, Prof. Johs. Schmidt has now come to those of New Zealand (*Trans. N.Z. Inst.*, vol. 58, 1927) and of Australia (*Records Aust. Museum*, vol. 16, No. 4, 1928). In both papers the author emphasises the necessity of employing numerical characters, such as the number of vertebræ and of fin rays, in the identification of species. In the case of the New Zealand eels, however, he finds that the number of vertebræ is not such a good distinctive character as in most other cases. The distance between the front of the dorsal fin and the vent $(a-d)$, expressed as a percentage of the total length (t), is the most important distinguishing feature. Two valid species of *Anguilla* are thus found in New Zealand—*A. aucklandi*, in which the average value $\frac{a-d}{t} \times 100 = 11.05$, and *A. australis* with an average value of 2.41. The former is distributed mainly in the south and west, the latter mainly in the north and east, but further data are required on this point. On the continent of Australia four species of eel are recorded—*A. australis*, *A. reinhardti*, *A. obscura*, and *A. bicolor*. Of these, the last named is an Indian form found in north-west tropical Australia. The three others are Pacific forms found on the east coast, one of which, *A. obscura*, is represented by only one specimen from the Burdekin River in the tropical part of Queensland. Between the *A. australis* of Australia and New Zealand there is an average difference of one vertebra, which in the author's opinion indicates a difference in their life-history and breeding places. These two papers on *Anguilla* are of particular interest and value, not only as further contributions to our knowledge of that genus, but also as examples of the application of variational statistical methods to the identification of species.

INHERITANCE OF WEIGHT IN RABBITS.—In former crosses between large and small rabbits by Punnett and Bailey and Castle, the large size was not recovered in F_2, and it appeared that inheritance of weight might not conform to ordinary Mendelian behaviour. But the numbers of animals bred were not very large. Mr. Michael Pease (*Jour. of Genetics*, vol. 20, No. 2) has since repeated these experiments on a larger scale. He crossed a Polish doe with a Flemish buck and bred an F_2 numbering 309 animals. The complete range of adult weights was obtained, from the mean of the small Polish stock to beyond the mean of the large Flemish stock. It thus appears that weight in rabbits can be explained on the multiple factor hypothesis. The mean weight for the Polish stock was about 50 oz. and for Flemish twice as much. The F_1 was intermediate and showed no sign of hybrid vigour. Only a few F_1 animals gave the whole range of weights in F_2, the majority giving a much more restricted range. Some of the light F_2 animals bred true in F_3, but no heavy animals bred true. It is not decided whether there is one predominating weight factor, but it is concluded that the weight factors act in a logarithmic manner. The Polish stock appeared to contain a simple factor for sterility, but there was also a slowly diminishing fertility which must be otherwise explained. The growth curve and times of maturity of these rabbits has also been carefully studied, as well as the relation of weight to sex, colour, and size of litter. From the F_2 population one strain was selected which matured in 172 days, and another in 300 days. In many of these rabbits there is no correlation between heavy weight and slow maturity.

CHROMOSOMES OF THE EARTHWORM.—L. Monné (*Bull. Int. Acad. Polonaise Sc.*, B, 1928) has investigated the chromosomes of the earthworm *Allolobophora fœtida* and finds that in the cells of the epidermis, nervous system, gut epithelium, and the developing muscles, nephridia, and septa, the number is 22, 11 pairs. The oogonia are known to have 22 (Foot and Strobell) and the author finds the same number in the spermatogonia.

PAIRING AND OVIPOSITION IN THE INDIAN APPLE SNAIL.—Prof. K. N. Bahl (*Mem. Ind. Mus.*, 9, pp. 1-11, 1928) records observations on pairing and oviposition in the Indian apple snail, *Pila globosa*. After a prolonged period of æstivation underground during the dry months, these snails come to the surface at the outset of the rains and at once pair in water on the ground at the edge of a pool. Pairing may last three hours, during which time the copulating animals may be handled and the principal relations of the male and female ducts ascertained. Prof. Bahl found that by electrocution he was able suddenly to kill a

couple of pairs, and by subsequent dissection to make out the precise details of the copulation The vas deferens of the male terminates in a papilla lying in the mantle cavity close to the rectum The penis sheath and penis are outgrowths of the mantle and are independent of the male opening Transference of the sperms from the vas deferens to the penis after the latter has been inserted into the mantle cavity of the female is effected by the genital papilla at the end of the vas deferens being directed into a depression at the proximal end of the penis The sperms then pass along the penis into the aperture of the vagina of the female Deposition of eggs takes place a day or two later in some sheltered hollow in the ground Each egg, after passing out of the vaginal opening, travels down an oblique tube formed by two temporary folds on the right side of the foot and is delivered into a dome shaped cavity under the foot formed by the arching of the creeping sole Each egg has a sticky covering, so the eggs, from 200 or 300 to 800 in number, adhere to form a mass When egg laying is completed the snail leaves the egg mass, there is no incubation of the eggs

CROSSES BETWEEN WHEAT AND RYE —Successful reciprocal crosses between wheat and rye are reported from the Saratov Experiment Station by Miss Nina Meister and Mr N A. Tjumjakoff (*Jour of Genetics*, vol 20, No 2) The variety of wheat used was *Triticum vulgare* var *erythrospermum*, and the rye was a local Russian form, 'Jelissejev' It was found that the reciprocal hybrids were alike, both resembling wheat and both sterile This is to be expected, since the wheat supplies 21 chromosomes and the rye but 7 No F_2 could be obtained, but the F_1 plants were crossed back with wheat or rye The pollination of rye by wheat appears now to be accomplished for the first time It is much more difficult than the reciprocal, giving only 2 5 per cent of successful fertilisations, as against 60 per cent for wheat and rye These results are very different from those obtained by Gaines and Stevenson in 1922, and it is suggested that the rye plants obtained by them from rye and wheat were not true hybrids

BOTANICAL CARTOGRAPHY OF EUROPEAN RUSSIA —The geo botanical department of the Leningrad Botanical Garden started some years ago, under the general editorship of Prof N I Kusnezow, and with the co operation of a number of Russian botanists, the compilation of a botanico geographical map of European Russia on the scale 1 1,050,000 that is, approximating closely to the scale 1 1,000,000 suggested for the maps of this kind by the International Botanical Congresses The whole map will be on twenty sheets Ten of these are ready, and three are already published covering the south eastern provinces, that is, the regions adjoining the middle and lower course of the Volga and the Caspian steppes The map is produced in colour and shows the distribution of different types of vegetation and partly even of the various associations As admitted in the explanatory pamphlet (such pamphlets, containing a brief description of the vegetation of the respective areas, will be published with each sheet), the map is not equally exact in all details, since it it based on numerous disconnected local vegetational maps, reports of expeditions, etc Some corrections will therefore be necessary after more detailed studies, and one of the main purposes of the map is to get together all results of previous botanico geographical explorations, so that the gaps will be obvious and may be filled Thus, the map is regarded as only the preliminary to another on the international scale Apart from the vegetational map, an additional sheet, on transparent paper, has been published with the fourteenth sheet (middle Volga region), showing some floristic data (limits of distribution of various typical plants) and the boundaries of the glacial deposits A general map of the vegetation of European Russia, on the scale 1 4,000,000, on a single sheet prepared by Prof N I Kusnezow, has also been just published by the Leningrad Garden

MARINE MOLLUSCA OF THE CHATHAM ISLANDS —Collections of shells were early made from the Chatham Islands, and Capt Hutton in his "Catalogue of the Marine Mollusca of New Zealand," 1873, was the first to give a connected account of their fauna Collections from several sources have now been studied by Dr H J Finlay (*Trans New Zealand Inst*, vol 59), who is able to record the occurrence of 202 species, of which 30 appear to be endemic The author considers that the present fauna is not a remnant, or evolution of the Tertiary faunas found there, but a repopulation from the mainland in post Pliocene times, yet still long enough ago for characteristic regional species and subspecies to have evolved The active factor in this repopulation has been ocean currents, acting from both north and south, but predominantly the latter In this list Dr Finlay treats all group names equally as full genera, this being in his opinion the handiest method for future reference, a course which those who have to consult the list, however, will scarcely agree with him is a matter of "no inconvenience" A more serious drawback to the list is that Dr Finlay has followed the order of families and genera given in Hedley's "Check List of the Mollusca of New South Wales" He has fortunately reverted to the usually adopted order of the classes, but a very cursory inspection would have shown him that the whole of Hedley's MS, confessedly sent off to the printer at short notice, must have got badly disarranged ere it reached the compositor, and never have been submitted in proof to the compiler How else to account, amongst other lapses, for the presence of the Gymnoglossa and the Architectonicidæ in the Opisthobranchia? It is a great pity that further currency should now be given to this unfortunate jumble Nevertheless, Dr Finlay's list will prove of great use to students of antipodean mollusca

SUBMARINE WAVES IN GIBRALTAR STRAITS —An upper lighter layer of variable depth lies upon denser water below, this upper, less saline, layer streams from the Atlantic into the Mediterranean, while the more saline water below runs out into the Atlantic, a certain amount at the boundary between the two layers mixing with the water above and being carried back into the Mediterranean G Schott, in the *Journal du Conseil International pour l'Exploration de la Mer* (vol 3, No 2, September 1928), reviews the available data bearing upon undulations which have been observed to occur in the boundary between the two layers This rises and falls twice a day with a well-marked tidal period, the rise taking place in the Straits while the tide is falling at Gibraltar The amplitude of these submarine waves is considerable, water at 14° C with a salinity of 37 4 per mille in the trough at 180 metres below the surface, rising to 100 metres below the surface when on the crest of the submarine wave some 7 h 40 m later It is shown that the boundary between the two layers is nearer the surface in the area over the ridge between Gibraltar and Africa than on either side The explanation of these movements of the boundary layer advanced by R de Buen, as 'injections' of water from below into the upper stratum, is disproved

THE DIFFRACTION OF ELECTRONS BY MICA.—A note published by S Kikuchi in the October number of the

Proceedings of the Imperial Academy of Tokyo contains a remarkable reproduction of an electron diffraction pattern. It was produced by passing a pencil of cathode rays—rendered homogeneous by magnetic sorting—through a very thin sheet of mica, and more than one hundred and fifty spots appear on it They are arranged in an equilateral triangular pattern, from the dimensions of which the spacing of the mole cules in the mica was calculated to be 5 11 A., the corresponding value obtained by an X ray analysis being 5 18 A The author has also had under in vestigation the relative intensities of other types of diffraction beams that are produced when electrons pass through thicker pieces of mica, and finds that there is a close parallelism betweem the distribution of intensities in electron beams and in the analogous beams of X rays The same is true of beams reflected from the cleavage faces of crystals, and electron diffraction has now been observed in this way with calcite, mica, topaz, zincblende, and quartz

ELECTRON WAVES —A very simple and convincing demonstration of the undulatory properties of elec trons has been given by E Rupp, who has described in a recent paper in the *Zeitschrift für Physik* (vol 52, p 8) how they may be diffracted by a ruled metal grating, with rather more than a thousand lines to the centimetre His apparatus was essentially a spectrometer of the type used for obtaining X ray spectra at grazing incidence under similar conditions, the electromagnetic waves being replaced by slow cathode rays moving with speeds corresponding to between 70 volts and 300 volts The set of spectrum photographs which has been reproduced shows dis tinctly that the cathode ray pencil passes away from the grating in certain privileged directions, as many as three orders of interference being apparent in one instance The quantitative agreement of the results with the de Broglie wave theory is also satis-factory, the predicted and measured wave lengths of the electrons agreeing to within a few per cent, whilst there seems to be no need to invoke the presence of an internal potential of the solid in this case No evidence was found that the electron waves were polarised, the author's conclusions in this connexion being confirmed by some new experiments by Drs Davisson and Germer which are mentioned in a recent *Bulletin* (No 5) of the American Physical Society

RADIUM AND GEOLOGY —A short account by C S Piggot of the relationship of radioactivity to geo logical phenomena is given in the *Journal of the American Chemical Society* for November There are three aspects of the problem, namely, the determina tion of the amount and distribution of radium throughout the lithosphere, the heat energy made available and the part it plays in mountain building, and, lastly, the estimation of geological time from the uranium lead ratio The amount of radium present in a rock may be determined by decomposing it by fusion with a flux and measuring with an electroscope the radium emanation thus liberated The estima tion of the age of a mineral from the uranium lead ratio cannot be entirely trustworthy until further data are available concerning the disintegration of the thorium series A measure of the relative amount of the lead derived from uranium would remove further uncertainty, and the author describes a method by which it is hoped to determine this by using Aston's mass-spectrograph.

AUTOMATIC SUBSTATIONS IN INDIA —The develop ment of automatic electric substations with super-visory control is making rapid progress In the *Metropolitan Vickers Gazette* for October there is a full description of the use made by the Bombay, Baroda, and C I Railway of automatic stations The economic value of these automatic stations is now widely recognised By their use the capital expenditure on buildings is reduced and there is a large saving in wages Complete and immediate information is given to the engineers at the generating station by means of suitable visible and audible signals There is no loss of time in receiving telephone reports and transmitting instructions to operators Should any machine be come overheated, the fact is automatically signalled to the control office A red lamp glows on the symbol for the machine on the control panel and an alarm bell rings The supervisor then starts another set and the red lamp glows until the overheated machine cools to its working temperature Blue lamps indicate when fuses blow, and when the fuse is replaced all the lamp signals are automatically checked Yellow lamps glow intermittently when selecting impulses are being sent out from the panel These and similar devices make supervisory control very effective Owing to the lack of skilled operators, it is particularly useful abroad The B B and C I Railway is claimed to be the largest and busiest in India, and the electrified section has the heaviest traffic All the electric power is got from the Tata hydro electric station situated in the Western Ghats, about 100 miles distant from Bombay It is transmitted by three phase alter-nating currents at a pressure of 110,000 volts It is transformed to 22,000 volts, and then transmitted by underground cables and overhead transmission lines

PERMALLOY ON SUBMARINE CABLES —In a paper communicated to the Royal Society in 1855, Lord Kelvin laid the foundation of the theory of submarine telegraphy This theory has since been greatly de veloped by mathematicians, and recently the dis covery of magnetic alloys of constant permeability has enabled the theory of Heaviside to be utilised in practice Notwithstanding these great develop ments, comparatively little attention has been de-voted to familiarising electrical engineers outside the small circle of submarine cable engineers with these advances The paper read to the Institution of Electrical Engineers by A E Foster, P G Ledger, and A Rosen on Dec 6 was the first paper on the subject for about thirty years The discovery of permalloy made possible the loading of telegraph cables and greatly increased the speed of signalling They explained the precautions that have to be taken during manufacture and the subsequent process of annealing A full description of the annealing fur nace through which the cable passes is given The inductance of the cable varies largely with the annealing temperature Further experimental in vestigation seems necessary to determine the best cycle of temperatures for heating and cooling The inductance also varies with the hydrostatic pressure The troubles introduced into cable working by the presence of electric power cables near their ends are not serious It is more difficult to overcome the interference due to natural causes These causes seem to be of the same nature as 'atmospherics' in radio communication Electromotive forces are set up and disturbances travel in both directions along the cable These may originate anywhere along the line, but the evidence shows that the disturbances are very small when the depth of the cable is 500 feet In order to get over interruptions due to natural phenomena, the earthing core is connected with the sheath at a point where the depth is at least 500 feet In several cases, however, these situations are un-fortunately several miles from the shore

Combustion in Gases

USEFUL service is rendered by *Industrial and Engineering Chemistry* to those engaged on the chemistry of flames in bringing together in a special number the papers presented at the symposium on combustion, held last September, by the Gas, Fuel, and Petroleum Divisions of the American Chemical Society

The first paper is one that claims attention both on theoretical and practical grounds, for it sets out to explain what is happening in the ordinary 'diffusion flame' of a gas jet burning in air The authors, Messrs S P Burke and T E W Schumann, seek to diminish the complexities of the problem by the use of a concentric tube arrangement in which the inner tube conveying the combustible gas is half the diameter of the outer tube conveying the air or oxygen, and the flow of the two streams is maintained at an equal rate Under these conditions, the authors claim that any increase in temperature due to the flame is counterbalanced by an increase in the rate of inter diffusion, and that variations in pressure do not affect the size of the flame

It will be noticed that such elongated flames as the authors employ are not strictly comparable with ordinary gas flames in air, which do not vary in height directly as the gas flow, and are affected by pressure, but nevertheless the results obtained are interesting—especially the comparison of the analyses of the products taken along the axis of the flame, with the theoretical deductions from the assumption that the flame front represents the boundary where the diffusion of oxygen inwards is just such as will combine completely with the gas diffusing outwards

An interesting contribution by A G Loomis and G St J Perrott, of the Bureau of Mines, deals with the temperature of non luminous flames determined by the optical method of Kurlbaum Fery The method depends on comparing the 'brightness' temperature of a solid radiator (heated electrically) with the brightness of the radiation from the gas air flame coloured with sodium vapour at a given spectrum line When the sodium lines from the coloured flame appear dark upon the brighter background of the continuous spectrum of the radiator the flame is cooler, but when the radiator is cooler than the flame, the sodium lines appear as bright lines By adjusting the current through the tungsten band lamp, the lines can be brought just to the 'reversal' point, when the temperature of the tungsten measured by the optical pyrometer gives the temperature of the flame —after correction for absorption by the focusing lens

In this way the authors measured the temperatures of a solid air gas flame (close to the orifices of the silica burners), when methane, propane, and carbon monoxide were mixed with different volumes of air The percentages of gas giving the maximum flame temperatures were found to be

	Per Cent of Gas.	Max Temp of Flame
Methane	9 8	1876° C
Propane	4 2	1930° C
Carbon monoxide	36 37	1960° C

To check the results the authors measured the temperature of a natural gas air mixture by the reversal method, and by the method used in the National Physical Laboratory at Teddington, in which the relation between the heating current and temperature of a refractory wire *in vacuo* and in the flame is determined. By the reversal method the temperature of the flame was found to be 1750° C, by the N P L. method the flame was 1770° C

Prof W E Garner discusses the effect of the presence of small amounts of hydrogen on the radiation of the carbon monoxide oxygen flame measured through a fluorite window at the end of an explosion-tube 80 cm long Measurements made in his laboratory at Bristol show that the radiation from the flame is reduced to one seventh by the addition of 2 per cent of hydrogen to the mixture, and the diminution is still considerable when the hydrogen is reduced to 0 005 per cent A marked change in the radiation—it is almost step like—was observed as the hydrogen content passes the 0 02 per cent point, this discontinuity would require for its explanation the occurrence of two different mechanisms of chemical action As bearing on this, it may be recalled that Weston has shown that the spectrum of the flame of the well dried carbon monoxide oxygen mixture, fired under high pressure, is far more luminous than the flame produced in the presence of hydrogen, and this has been interpreted to mean that carbon monoxide may combine directly with oxygen and also indirectly by the reduction of steam

Messrs F A Smith and S F Pickering exhibited photographs of propane air and acetylene air flames produced by forcing the mixtures through a tube, and either allowing access of secondary air or excluding it In some cases the flames become polyhedral, and can be made to rotate slowly or rapidly according to the gas content of the mixture

A photographic study of the 'flicker' shown by ordinary luminous flames was presented by Messrs D S Chamberlin and A Rose, of the Lehigh University With a kinematograph camera taking 32 pictures per second, the upper portion of the flames was shown to move upwards, and then to fall very rapidly, or be extinguished—for in some cases two completely separated flames are photographed on the same picture With natural methane, ethane, and ethylene burning from an orifice rather less than 1 mm in diameter, the rate of flicker was about 10 per second, and the amplitude about 4 to 5 cm

Mr F W Stevens, of the Bureau of Standards, has made photographic measurements of the spread of the flame in carbon monoxide oxygen mixtures when fired centrally in soap bubbles, by which device the flame may be imagined to spread through a gas mixture unconfined in space—and under constant pressure The flame was found to proceed at a uniform rate, but the rate deduced from the inclination of the line of the flame front (being the rate through space) is greater than the velocity of the 'reaction zone' relative to the gas it is entering Mr Stevens shows that the true rate of the flame is greatest with the theoretical mixture $2CO + O_2$ The rate of the flame in methane oxygen mixtures has also been studied, and the author finds that when the methane is increased beyond that required for complete combustion, the rate of propagation of the reaction zone falls off abruptly Generally, the author is convinced that the bubble is an efficient experimental gas engine operating with minimum heat losses and negligible friction against the pressure of the surrounding atmosphere

The work of the Sheffield School (1) on the slow uniform phase of gaseous combustion, and (2) on the initial spread of the flame and its arrest when gas mixtures are fired centrally in a cylindrical tube, is summarised by Dr Payman

(1) The speed of flame in the limit mixtures (*i e* those just propagating flame) of various inflammable gases with air has been found to be close on 20 cm./sec, but notable exceptions are presented by hydrogen and acetylene mixtures

(2) When hydrocarbon air mixtures are fired in the centre of a cylinder 5 cm in diameter, and the flame is photographed on a moving film through a narrow horizontal window, the front of the flame towards each end is seen to increase in speed until it is suddenly checked and then proceeds at a nearly uniform rate to the end of the cylinder As the point of arrest is shown to coincide with the moment when a belt of the expanding globe of flame reaches the cold walls, it is suggested that the arrest is due to the cooling (or extinction) of the flame by the contact, and to the consequent loss of pushing power behind the flame fronts Very rapid snap shots of the flame in clear cylinders show that it starts as a sphere from the central spark, then becomes egg shaped, and finally breaks into two when the equatorial belt reaches the side wall The snap shots also show the re illumination of the central portion after the flame has reached the ends of the vessel, indicating that the combustion was not complete when the flame front has traversed the cylinder

Messrs J V Hunn and G G Brown describe an apparatus in which the passage of a flame may be photographed on a moving film at the same time that pressures are registered at four points along a cylinder of 3 inches diameter Using carbon disulphide with excess of oxygen, the authors show that a pressure wave travels from the igniting spark ahead of the flame front and, being reflected from the farther end, returns to the firing end, passing through the flame *en route*, again reflected from the firing end, but travelling faster through the heated gas, it may over take the flame front, and in so doing cause a halt and even a reversion of the flame This is a new interpreta tion of the 'halt,' and one not easy to follow on the published photograph Obviously the method is a promising one and should be pursued

In the United States, where it is said a motor car is registered for every five inhabitants, a conference on gaseous combustion was bound to deal with 'knock' and 'anti knock' Prof Wheeler and G B Maxwell contribute the results of their experiments in a 6 inch cylinder of 15 inches length, in which pentane and benzene air mixtures were fired with a spark near one end plate and a pressure gauge in the other end The flame was photographed through a narrow window When a 3 per cent pentane air mixture is fired at atmospheric pressure, the flame travels with accelerating speed until, just beyond half way, it is checked and then proceeds slowly to the end the pressure recorded shows an even rise, a check corresponding to that of the flame, and then a rise to the maximum when the flame reaches the end When the pentane is increased to 3 5 per cent the flame begins to vibrate after the central check, and when it reaches the end sends back a very rapid luminous wave With increase of initial pressure to 2 or 3 atmos, the explosions are distinctly audible, and the vibrations are more violent with the 3 5 per cent mixture The gauge shows a sudden rise of pressure as the flame reaches the end, and the photo graphs show an intense glow traversing the cylinder Similar benzene air mixtures gave but feeble vibrations and no shock wave

The addition of lead tetra ethide, 2 5 ounces to the gallon of pentane, greatly increased the violence of the explosion, but when the lead compound was first decomposed, and the cloud swept in with the charge, a continuous combustion was observed and no shock wave was recorded These experiments confirm the view of Egerton and Gates on the anti knock effect

Messrs T E Layng and M A. Youker describe a glass apparatus for determining the rate of oxidation of various fuels when heated in oxygen They show that *n* heptane is oxidised fairly readily at 160° C, but this oxidation is prevented by small additions of lead ethide or of potassium ethylate On the other hand, kerosene could be kept for eight hours in oxygen at 180° C with very slight alteration, but the addition of 0 05 per cent of lead ethide to the liquid produced marked oxidation, while the addition of 1 per cent of aniline or of diphenylamine had no effect It is suggested that an efficient anti knock must retard gas phase oxidation and accelerate liquid phase oxida tion

Other interesting papers deal with the partial oxidation of methane and ethane in the presence of catalysts, and the relative rates of oxidation of the olefines in flames and liquid oxidising agents

Development Commission Report, 1927–28 [1]

THE reports of the Development Commission show how great a stimulus the Development Fund has been to research in agriculture and horticulture since its introduction in 1911 Grants in aid prior to this were dispensed with a meagre hand, hence major in vestigations requiring a large equipment and manifold repetition, as in the case of animal diseases, could scarcely be carried on This eighteenth report con veys, however, an impression that the progeny of the Fund have become too numerous, and that the ex pansion inevitable in scientific investigations has outrun the capacity of the Fund Thus large supple mentary grants have been given by the Empire Marketing Board to the Welsh and Scottish Plant Breeding Stations for buildings, etc, to research in woollen industries, and to agricultural economics research at Oxford

The total advances from the Development Fund for 1927–28 were about £383,000, as compared with £403,000 the previous year The ordinary Develop ment Fund contributed £253,000, the residue coming from the Special Fund (Corn Production Acts, 1921), but this latter source appears from the accounts now to be exhausted The larger part of the funds is applied in aid of two schemes, research institutes in agriculture and advisory centres The grants de tailed for each centre show little change from the previous year The new grants include two for in vestigations on the virus diseases of the potato, to the Cambridge and Scottish Plant Breeding Institute, respectively A committee set up to investigate foot and mouth disease received the substantial grant of £15,000 An important development, still in its initial stages, is the Scottish Dairy Research In stitute, which has been rendered possible by a private gift of a mansion and estate at Auchencruive, near Ayr, valued at £20,000, and a bequest of £26,000 The Development Commissioners have agreed to recommend sums up to £52,000, subject to local con tributions, over a period of four years

Amongst the reports on institutes there is evidence of considerable activity in those devoted to horti culture, which appear to be well supported by grants

Reference is made to the much debated subject, how best to secure co-ordination of research This was discussed at some length at the Imperial Agri cultural Conference in 1927, and at least one scheme was proposed for exchange of reports on work, which was over elaborate. A summary of agencies available

[1] Development Commission Report of the Development Com missioners for the year ended March 31, 1928." (London H.M. Stationery Office, 1928.) 3s 6d. net.

in Britain for conference and exchange of information shows that home workers have reasonable opportunities, but there is still room for linkage with other parts of the British Empire Endeavours have been made to fill the gap by conferences, but of course attendance is possible only for a limited number and at considerable cost

This leads to the vexed question of technical publications Few research institutes have libraries anything like adequate for their needs, and in recent years estimates for libraries have been severely pruned, and the situation exists that institutes receiving State aid have to purchase government publications at booksellers' prices The same economy is evident when an institute wishes to publish its results, and to circulate them Printing estimates are censored, so that authors must wait their turn for publication in journals already overcrowded

The present report suggests that the policy to aim at is the wider distribution of semi popular publications and bulletins Much depends on the meaning attached to 'semi popular,' for matter set out for a newspaper or a farmer's weekly would probably be of little use to the specialised investigator, but what the report suggests seems to be the condensed summary such as a specialist presents to his colleagues at a conference Some good examples of the kind of information useful for co ordination will be found among the summaries of work in this report These occupy the greater part of the report, and with the appendices (30 pages) giving the titles of monographs, etc , published during the year by each institute receiving grants, indicate the wide field of research covered by the Development Fund

University and Educational Intelligence

LONDON —The title of professor of zoology in the University has been conferred on Dr H G Jackson as from Aug 1 last, in respect of the post held by him at Birkbeck College Prof Jackson was appointed to the University readership in zoology at that College in May 1921, and has published numerous papers on isopods in the *Proceedings of the Zoological Society*, the *Annals and Magazine of Natural History*, and other biological journals

IT is about two years since what is frequently referred to as the Hadow Report was issued So powerful an impression did it make, and so widely was it discussed, that it seems almost unnecessary to explain that it was a report by the Board of Education's Consultative Committee dealing with the organisation, objective, and curriculum of courses of study for children (other than those attending secondary schools) who will remain in full time attendance up to the age of fifteen years, regard being had to their probable future occupations The report received almost general approval from all types of educational and social workers The Board of Education has since issued its Circular 1397 and its "New Prospect in Education," in which it indicates how some of the recommendations of the Hadow Report may be applied to the educational system In a pamphlet entitled "The Hadow Report and After," the Executive Committee of the National Union of Teachers has attempted to set forth constructive criticism of these documents It is made clear that the purpose of any criticism is not to impede advance, but to offer the results of the N U T 's experience in the solution of the very difficult problems involved To the detailed arguments in chapters which include the regrading of education, unity in the post primary system, barriers to unity, age of transfer, size of classes, and curriculum of the senior school, are added fifty-five recommendations The work, which is being widely circulated to interested persons, ought to do much to stimulate thought in connexion with the important problems discussed The pronouncements made, of course, are those of the National Union of Teachers, we cannot avoid feeling that, since other teachers' associations are so closely concerned, the securing and inclusion of their views would have been a considerable advantage

THE Collège des Ecossais, founded by Prof Patrick Geddes as a hall of residence for students pursuing courses of study in the University of Montpellier, has justified the hopes of its founder and demonstrated the existence of a demand for such accommodation in excess of its capacity Plans have now been completed for erecting beside it a new and larger building This will more than double the accommodation at present available, which only suffices for about twenty students The foundation stone of the new building was laid on Oct 18 by the Rector of the University, M Coulet, who, in his inaugural address, recalled the fact that Prof Geddes had himself been a student there forty years ago, and emphasised the significance of the new undertaking as an agency promoting international understanding and world peace The Mayor of Montpellier added his felicitations and promised to give all the help he could in regard to such matters as electricity and water supply, while the Secretary General on behalf of the Prefect hailed Prof Geddes as a valued friend of France and of Montpellier A telegram was received in the course of the proceedings from the Franco Scottish Association of the University of Edinburgh, where Prof Geddes is well known for his indefatigable labours in the cause of improving the conditions of residence of the students At Montpellier special courses are offered by the faculty of sciences in chemical engineering and in œnology and there is a fuels institute for advanced students In connexion with the zoological laboratories is a marine biological station at Cette Attached to the well known botanical gardens is the Mont Aigonal laboratory for research on mountain flora

THE Royal Technical College, Glasgow, has sent us its report on the session 1927–28—the twenty fifth since King Edward VII laid the memorial stone of what is claimed to be the largest single structure in Britain devoted to education Experience has demonstrated the enormous benefits accruing from the establishment under one roof of laboratories belonging to the various departments—physics, chemistry, metallurgy, engineering, bacteriology — formerly housed in seven detached, scattered, and obsolete buildings It has also justified the extensive scale on which the chemical laboratories were planned—a scale strongly criticised at the time as extravagant Since then much of the more elementary work and the whole of the craft classes have been transferred to the Glasgow Education Authority, and accommodation has thus been made available for a great expansion of advanced study and research in connexion with the countless scientific problems arising in the various industries with which the College is associated The staff has increased during this period from 29 to 93 A significant event in the recent history of the College is the establishment of the New Development Fund initiated by the former chairman of the governors, Sir George Beilby, and indications of the success that has attended the administration of this fund are to be found in the fifty eight original papers which have been published in the College *Research Journal*, now in its fifth year, and in the large and increasing number of requests from local firms for help in dealing with problems arising from the use of new alloys and other materials

Calendar of Patent Records

January 1, 1905 —Previous to 1905 no question as to the novelty of an invention for which a patent was being sought was raised by the British patent office, but under the provisions of the Patents Act, 1902 (2 Edw 7, cap 34), which came into force on Jan 1, 1905, an official search for novelty was instituted , the examination, however, extending only to completed British patent specifications on applications not more than fifty years old This limited search has not been altered by later Acts and is still the practice of the office, some 21,000 specifications being so examined each year

January 3, 1561 —One of the earliest of English industrial monopoly patents was for the manufacture of soap Soft soap was at that time the only kind made in England, and the patent is evidence of an attempt to introduce into this country the hard soap industry of Marseilles and Spain The grant was for ten years from Jan 3, 1561, to Stephen Groyett and Anthony Leleuryer to make white hard soap "like of goodness fynes and puritie as the sope is which is made in the sope houses of Triana or Syvile" and it contained a clause to the effect that two at least of the workmen were to be of English birth The grant also stipulated that the soap was to be subject to inspection by officers appointed by the Lord Mayor and the Lord Chancellor, and that the patent would be voided if the soap were found to be deficient in quality It is improbable that the invention was put into successful operation

January 3, 1839 —The atmospheric system of railway propulsion attracted general attention in England and on the Continent during the forties of last century Under it a train was propelled by means of atmospheric pressure acting on a piston working in a continuous tube laid between the rails a vacuum being created in front of the piston by stationary engines situated at convenient intervals along the line The piston was connected to the first carriage or 'locomotive' by means of a rod working through a slot in the top of the tube, and the great difficulty of the early experimenters lay in the design of a valve for the slot which would open and shut satisfactorily on the passing of a train Samuel Clegg was the first to find a practicable solution, and he patented his invention on Jan 3, 1839 In conjunction with Jacob Samuda, of the Southwark Bridge Iron Works, he laid a short length of line for the Dublin and Kingstown Company between Dalkey and Kingstown which was opened in March 1843 Other lines were projected, notably one from Croydon to Epsom and London, part of which was built and opened, but the cost of working and other difficulties proved too great, and all the lines were closed down before 1848

January 5, 1769 —It is unnecessary nowadays to emphasise the fact that James Watt did not invent the steam engine, but his achievements nevertheless entitle him to rank as one of the world's outstanding inventors His first engine—the patent for which was granted on Jan 5, 1769—doubled the efficiency of the old Newcomen engine and directly contributed to the great expansion of industry that took place during the latter part of the eighteenth and the nineteenth centuries In 1775, Parliament extended the life of the patent, and it was not until 1800, after Watt himself had retired from active business, that the monopoly rights expired By this time the new business of steam and mechanical engineering, which the success of the Watt engine had called into being, was definitely established

January 7, 1625 —Wheeled coaches were introduced into England about the middle of the sixteenth century, and became increasingly popular in spite of restrictive legislation which, until the coming of the Turnpike Acts, attempted to fit the traffic to the roads rather than to improve the latter Many attempts were made to render the coaches more comfortable and safe A patent was granted to Edward Knappe on Jan 7, 1625, for a coach in which the wheels and axle trees were so placed and constructed "as in an instant of tyme the wheels maie be shutt closer together where the narrownes of the waie shall require itt without anie danger, or to be enlarged and sett wydor as shall be most safe and easey for the passenger as alsoe by hanging the bodie of the coach to the carriage by two springs of steele before and two behinde for the more ease of the treveller" No specification was enrolled and nothing is known about the actual construction Springs did not come into use until some time later

January 7, 1714 —Though typewriters were not in general use until toward the end of last century, British patent records and those of other countries show that for a long period there had been a serious and sustained effort to solve the problem of 'mechanical writing' The earliest patent for such a machine was granted in England to Henry Mill, the engineer of the New River Company on Jan 7, 1714, with the title "An artificial machine or method for the impressing or transcribing of letters singly or progressively one after another as in writing, so neat and exact as not to be distinguished from print" No description of the apparatus has come down to us

January 9, 1854 —Glycerine was discovered by Scheele in 1779, but it did not find extensive application until very much later It was known that it formed a large part of the spent lyes from soap making, but there was no great demand for it and no suitable method for its recovery, the small quantities which were required for medicinal purposes being made by saponifying oil with litharge It was not until G F Wilson, of Price's Candle Co , introduced the process of separating the glycerine from the fat acids by means of steam at a high temperature that a pure glycerine could be economically obtained in large quantities Wilson's process was based on that of R A Tilghman which consisted in forcing an emulsion of fat and water through a coiled pipe heated in a furnace to a temperature of about 330°, for which a patent was granted on Jan 9, 1854 The discovery of nitroglycerine as an explosive by Nobel in 1863 greatly increased the demand for glycerine

January 9, 1857 —'Aerated bread' was made under the patent (2293 of 1856) granted to John Daughlish, which was sealed on Jan 9, 1857 The invention consists of a process for aerating the dough without the addition of yeast or the usual chemical compounds Carbon dioxide is forced into water under pressure and the charged water is then used for converting the flour into dough, the operation being carried out in a kneading machine in which the pressure is maintained until the kneading is completed

January 11, 1841 —Alexander Bain was one of the pioneers in the application of electricity to clocks, his first patent, which describes a master clock system, being dated Jan 11, 1841 The pendulum of his clock carries a coil in place of the bob, which moves in the field of two fixed magnets with north poles adjacent, a make and break device regulating the current to the coil so that the pendulum receives an impulse once in every swing to the right

Societies and Academies

DUBLIN

Royal Irish Academy Dec 10 —**A Farrington** The pre glacial topography of the Liffey basin In pre glacial times the present Liffey basin was divided between the catchments of two separate streams One of these catchments included the hill encircled basin of the upper Liffey and the Kings River From this area the drainage escaped in a westerly direction The second catchment was that of the Rye Water river which flowed eastwards to Dublin Bay The portion of the present Liffey which connects these two basins is post glacial in date The theory that the diversion of the upper Liffey was due to the lowering of the valley by glacial scour is discussed and rejected The development of the present course of the Liffey is traced from its initiation as a consequent stream on a westward sloping plain This plain was certainly post Cretaceous and is probably of mid Tertiary age

ROME

Royal National Academy of the Lincei Communications received during the vacation 1928 —**G Giorgi** New observations on the functions of matrices —**Q Majorana** and **G Todesco** Preparation of the thallium photoelectric cell A quick acting photo electric cell at least as sensitive as that of Case may be prepared from thallium sulphide —**L A Herrera** Imitation of organised forms by albumen and hydro fluoric acid Treatment of egg albumen with hydro fluoric acid either pure or diluted with water or glycerine gives rise to structures having the micro scopic appearance of hyaline or granulated masses either nucleated or non nucleated —**T Boggio** Rie mann s homography relative to a curved space —**J Delsarte** The composition of second space —**H Geppert** Adiabatic invariants of a differential generic system A rigorous definition is given of the concep tion of adiabatic invariant for any differential system the problem of finding these invariants in the case of two or more dimensions is to be resolved later —**R Caccioppoli** The definition of the area of a surface The author s semi analytic definition of the area of a curved surface based on the notion of an element of area, is supplemented and is shown to be of value in integrating and throwing light on certain recent obser vations of various authors —**A Rosenblatt** The singu larity of the solution of a system of ordinary differential equations —**A Signorini** Asymptotic expression of a formula of Levi Cività —**E Pistolesi** Further obser vations on Kutta Joukowski s theorem in the case of a plane lamina From a discussion of various papers which have lately appeared on this subject it is concluded that owing to the essential singularities presented by the current at the angles of the lamina the problem cannot be solved by the orthodox methods of analysis but that it requires treatment as a limiting case of a contour devoid of singularity which, by deformation, tends to become confused with the segment counted twice that the suction at the corners necessary for the validity of Kutta Joukowski s theorem, naturally finds a place in the problem so considered, and that such validity may be assumed also for Cisotti s lamina and in all analogous cases —**E Persico** Optical resonance according to wave mechanics The approximate method proposed by Fermi for taking account of the reaction of radiation in wave mechanics is applied to the development of the theory of optical resonance from the point of view of Schrödinger's mechanics —**R Deaglio** The Volta effect in air and moist surface films Experiments show that, in a dry medium, the pile effect disappears completely, whereas the Volta effect remains practi cally unchanged Hence the moisture of surface films, necessary to create the pile effect, is without sensible influence on the Volta effect —**E Oddone** Interpretation of superficial seismic waves Explana tion of surface seismic waves is somewhat simplified on the basis of the probable existence of Mohorovicic s sur faces of discontinuity and on the values of the velocity of longitudinal waves in and beyond the earth s crust, 57 kilometres in thickness The slow waves may be considered as analogous to the infra sounds of acoustics, that is as waves transformed by distance and multiple reflections —**B Castiglioni** Circulation in the southern Adriatic (2) The currents governing the circulation of the water through the Straits of Otranto are dis cussed —**G Scagliarini** and **P Pratesi** The reaction between sodium nitroprusside and sulphides Stable, homogeneous crystalline compounds such as $K_3Fe(CN)_5NO\ K_2S$ may be obtained by treating a dry nitroprusside with an anhydrous sulphide in abso lute methyl alcohol solution The action of the sul phide on the nitroprusside appears to be analogous to that of alkalis —**P Gallitelli** Laumontite from Toggiano Two types of laumontite exist (1) a compact form of almost fibrous structure and nacreous lustre and (2) a finely granular almost earthy variety which crumbles at the slightest shock and differs in composition from the other principally in its lower content of water The percentage losses of water in the two cases are nearly the same for tem peratures below 400 but diverge at higher tempera tures It seems unlikely that the friable form has originated by dehydration of the more compact kind —**M Anelli** and **A Belluigi** Confirmation of geological inductions and of geophysical results —**B Monterosso** Cirropedological studies (4) Phenomena which pre cede anabiosis in *Chthamalus* —**F Dulzetto** Obser vations on the sexual life of *Gambusia holbrooki* (Grd) Contrary to statements made the sperms of *G hol brooki* are capable under certain conditions of pre serving in the body of the female their fertilising power from one year to another The sex of the generations produced in such conditions is under in vestigation —**Maria De Cecco** Application of ultra violet rays to the examination of fluorescent substances in plants in relation to certain phenomena of vegetable pathology

SYDNEY

Linnean Society of New South Wales Oct 31 —**I M Mackerras** New Australian Mydaidæ (Diptera) Description of five new species one of *Diochlistus* and four of *Miltinus* and notes on other species —**J R Malloch** Notes on Australian Diptera No 17 The paper contains notes on the Ceroplatinæ (fam Mycetophilidæ) the genus *Pachyneres* some Asilidæ, and some already described species of *Cyclorrhapha* —**Rev H M R Rupp** Notes on *Corysanthes* and some species of *Pterostylis* and *Caladenia* —**H J Carter** Revision of *Hesthesis* (Cerambycidæ) together with description of a new genus and species of Buprestidæ Three new species (or subspecies) of *Hesthesis* a new species of *Epania* and a new genus belonging to the group Anthaxites of the Buprestidæ are described —**I V Newman** The life history of *Doryanthes excelsa* (Corr) Part 1 Some ecological and vegetative features and spore production The development of the floral organs suggests the leaf shoot nature of the flower the carpels showing very clearly the form of involute leaves The microsporangium suggests that of eusporangiate Filicales *D excelsa* appears to be primitive among the Amaryllidaceæ

WASHINGTON D C

National Academy of Sciences (*Proc*, Vol 14, No 10, Oct 15) —**L Brillouin** Is it possible to test by a

direct experiment the hypothesis of the spinning electron? Suppose that a beam of electrons enters a weak magnetic field nearly normally, the electrons will begin to move in spirals towards the pole of the magnet, and an electrode placed near the pole would collect the electrons. If the electrons have an electric moment, the current to the electrode will drop suddenly to half its value as the direction of the incident electrons approaches the normal to the magnetic field. The experiment will be difficult to carry out.—**Benedict Cassen**: On the distribution law in locally rapidly fluctuating fields which are steady when averaged over a sufficient time interval. In determining the time average electrical potential round the nucleus of a heavy atom, the use of the statistical distribution law of an ideal gas in a steady field is not justified; a 'correlation potential' must be used.—**Frank Peat Goeder**: The crystal structure of potassium sulphate. A quantitative three dimensional structure is proposed which gives diffraction effects in good agreement with those observed in X ray powder photographs.—**Carl Barus**: Further experiments in microbarometry.—**Jos E Henderson** and **Elizabeth R Laird**: Reflection of soft X rays. The curves showing the relation between percentage reflection from glass and glancing angle have no discontinuity corresponding to a critical angle and total reflection such as is found with short wave length X rays. The results can be explained by taking into account the absorption.—**Mabel K Slattery**: Fluorescence and solid solution. Small quantities of uranium dissolved in fused alkali fluorides gives brilliant and resolved fluorescence spectra at the temperature of liquid air. It seems that the uranium goes into uniform solid solution, replacing an atom of the alkali element here and there in the crystal lattice, and produces no measurable change therein.—**E C Kemble** and **V Guillemin, Jr**: Note on the Lyman bands of hydrogen.—**Lee A DuBridge**: Systematic variations of the constant A in thermionic emission. A form of the Richardson Dushman equation is developed in which the observed variations of A can be ascribed to a small temperature variation of the surface work function.—**R C Williamson**: (1) The photoelectric long wave limit of potassium vapour. There appear to be two types of *molecular* ionisation, one without and the other with dissociation.—(2) Emergent energy of photo electrons in potassium vapour.—**Edwin H Hall**: Electric conductivity and optical absorption of metals. An argument based on the associated electron theory of conduction, namely, that conduction is partly by free electrons sharing the thermal energy but mainly by the interchange of electrons in encounters between atoms and positive ions, the latter being naturally equal in number to the free electrons.—**Clyde E Keeler, Evelyn Sutcliffe**, and **E L Chaffee**: A description of the ontogenetic development of retinal action currents in the house mouse. Using the intact unanæsthetised animal, it is found that the first visible potential difference on illumination occurs on the 13th 14th day after birth. The reaction in young mice is different from that in older animals, but it gradually takes on the adult form.—**L C Dunn**: A fifth allelomorph in the agouti series of the house mouse.—**G A Miller**: Determination of all the groups which contain a given group as an invariant subgroup of prime index.—**Charles E Hadley**: Colour changes in excised pieces of the integument of *Anolis equestris* under the influence of light. Patches of dorsal skin of this Cuban lizard in physiological salt solution in direct sunlight change from green to dark brown in 40 sec., and 12 sec. after removal to the shade become green again. Similar changes occur in the live animal, and also with the stimulation of excitement, but much more slowly. As regards the excised skin experiments, the melanophores must be capable of expansion and contraction when isolated from the action of hormones and the nervous system; possibly impulses are received from end organs left intact in the skin, or light may have a direct effect on the melanophores.

Official Publications Received

British

Proceedings of the Royal Society. Series A. Vol. 121, No. A788. Pp. 477-681+xiii. (London: Harrison and Sons, Ltd.) 8s.

Royal Agricultural Society of England. Agricultural Research in 1927. Pp. viii+190. (London: John Murray.) 1s.

Observations made with the Cookson Floating Zenith Telescope in the Years 1911-1927 at the Royal Observatory, Greenwich, for the Determination of the Variation of Latitude and the Constant of Aberration under the direction of Sir Frank Dyson. Pp. 67. (London: H.M. Stationery Office.) 7s. 6d. net.

Department of Scientific and Industrial Research. Report of the Water Pollution Research Board for the Year 1927-8. Pp. iii+18. (London: H.M. Stationery Office.) 6d. net.

Foreign

Proceedings of the Academy of Natural Sciences of Philadelphia. Vol. 80. Fishes from Florida and the West Indies. By Henry W. Fowler. Pp. 451-473. (Philadelphia, Pa.)

Ministry of Public Works, Egypt. Physical Department Paper No. 24: The Measurement of the Discharge of the Nile through the Sluices of the Aswan Dam. Final Conclusions and Tables of Results. By Dr. H. E. Hurst and D. A. F. Watt. Pp. v+44+4 plates. (Cairo: Government Publications Office.) 10 P.T.

Civil Aeronautics: Legislative History of the Air Commerce Act of 1926 Approved May 20, 1926, together with Miscellaneous Legal Materials relating to Civil Air Navigation. Revision of the 1928 edition of Law Memoranda upon Civil Aeronautics. Corrected to August 1, 1928. Pp. v+178. (Washington, D.C.: Government Printing Office.)

Reprint and Circular Series of the National Research Council. No. 83: Sixth Report of the Committee on Contact Analysis. By Robert E. Burk, in collaboration with other Members of the Committee. Pp. 47. 50 cents. No. 84: I. The Fourth Census of Graduate Research Students in Chemistry, 1927; II. Support of Graduate Research in Chemistry in American Universities, 1927-1928. Compiled by Clarence J. West and Callie Hull. Pp. 13. 20 cents. (Washington, D.C.: National Academy of Natural Sciences.)

Cornell University Agricultural Experiment Station, Ithaca, New York. Bulletin 467: Tomato Fertiliser Experiments in Chautauqua County, New York. By Paul Work. Pp. 24. Bulletin 469: The Collection of General Property Taxes on Farm Property in the United States with Emphasis on New York. By M. Slade Kendrick. Pp. 51. (Ithaca, N.Y.)

Diary of Societies

Friday, January 4

Royal Geographical Society (at Æolian Hall), at 3.30.—Dr. H. R. Mill: Capt. Cook's Quest of the Southern Continent (Christmas Lectures to Young People) (II.).

Institution of Mechanical Engineers (Informal Meeting), at 7.—Major A. W. Farrer: The Engineer Salesman Abroad.

Royal Photographic Society of Great Britain (Informal Meeting of Pictorial Group), at 7.—Discussion on the Prints in the Holcroft Collection.

Geologists' Association (at University College), at 7.30.

Society of Chemical Industry (South Wales Section) (at Thomas Café, Swansea).—A. Grounds: Preparation of Coal for the Market.

Saturday, January 5

Royal Institution of Great Britain (at Institution of Electrical Engineers), at 3.—A. Wood: Sound Waves and their Uses (V.): The Ear and What it does (Juvenile Christmas Lectures).

Monday, January 7

Royal Society of Edinburgh, at 4.30.—Prof. H. S. Allen: Remarks on Band Spectra.—Dr. I. Sandeman: The Fulcher Bands of Hydrogen.—F. B. Hutt: (a) On the Relation of Fertility in Fowls to the Amount of Testicular Material and Density of Sperm Suspension.—Studies on Embryonic Mortality in the Fowl: (b) Part 1. The Frequencies of Various Malpositions of the Chick Embryo and their Significance.—F. B. Hutt and A. W. Greenwood: (a) Part 2. Chondrodystrophy in the Chick; (b) Part 3. Chick Monsters in Relation to Embryonic Mortality.—L. A. Harvey: The Oogenesis of *Carcinus mænas* Penn., with Special Reference to Yolk Formation.—J. Wishart: The Correlation between Product Moments of any Order in Samples from a Normal Population.

Victoria Institute (at Central Buildings, Westminster), at 4.30.—Dr. W. Bell Dawson: The Hebrew Calendar and Time Periods.

Institution of Electrical Engineers (Mersey and North Wales (Liverpool) Centre) (in Laboratories of Applied Electricity, Liverpool University), at 7.—W. B. Woodhouse: Overhead Electric Lines.

BRADFORD TEXTILE SOCIETY (at Midland Hotel, Bradford), at 7 30 —A. M Chapman The Application of Worsted Yarns to Dress Goods and Coatings

SOCIETY OF CHEMICAL INDUSTRY (London Section jointly with the Fuel Section) (at Burlington House), at 8 —J I Graham The Action of Hydrogen upon Coal

ROYAL INSTITUTE OF BRITISH ARCHITECTS at 8 —Dr O Faber The Expansion and Contraction of Building Materials due to Temperature Humidity Stress and Plastic Yield

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall) at 8 30 —C H Karius The First Crossing from the Fly River to the Sepik New Guinea

INSTITUTION OF THE RUBBER INDUSTRY (London Section) (at Blackfriars Theatre E.C) —F W Bennett Factory Organisation in the Rubber Industry Affecting the Conditions of the Worker

TUESDAY JANUARY 8.

ROYAL INSTITUTION OF GREAT BRITAIN (at Institution of Electrical Engineers) at 3 —A. Wood Sound Waves and their Uses (VI) How Sounds are Recorded and Reproduced (Juvenile Christmas Lectures)

INSTITUTION OF PETROLEUM TECHNOLOGISTS at 5 30

ROYAL SANITARY INSTITUTE at 5 30.—Prof A Bostock Hill and others Discussion on Cleanliness Is it the Basis of Health?

INSTITUTION OF CIVIL ENGINEERS, at 6

INSTITUTE OF MARINE ENGINEERS at 6 30.—J Calderwood The Diesel Engine for Passenger Ships and Fast Cargo Liners.

INSTITUTION OF ELECTRICAL ENGINEERS (North Western Centre) (at Engineers Club Manchester), at 7 —J L Carr Recent Developments in Electricity Meters with particular reference to those for special purposes

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group) at 7 —A H Blake London through the Eyes of Hogarth

BURNLEY TEXTILE SOCIETY (at Mechanics Institute Burnley), at 7 15 —H C Barnes Conditions in Cotton Manufacturing Abroad

INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at Royal Technical College Glasgow), at 7 30

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Middlesbrough Branch) (at Cleveland Scientific and Technical Institution, Middlesbrough) at 7 30 —W T Butterwick and others Informal Discussion on Shipbuilding

QUEKETT MICROSCOPICAL CLUB, at 7 30 —W N Edwards Microscopical Study of Fossil Plants

INSTITUTION OF AUTOMOBILE ENGINEERS (at Royal Society of Arts), at 7 45 —Dr F W Lanchester Coil Ignition

HULL CHEMICAL AND ENGINEERING SOCIETY (Grey Street Hull) at 7 45 —G R Adamson and C F Tinker Electric Cranes.

ROYAL SOCIETY OF MEDICINE (Psychiatry Section) at 8 30 —Discussion The Use of Artificial Sunlight in Mental Hospitals

PHARMACEUTICAL SOCIETY OF GREAT BRITAIN (North Metropolitan Branch) (at 17 Bloomsbury Square) at 9 —G Fletcher Ireland Its Scenery and People

WEDNESDAY JANUARY 9

GEOLOGICAL SOCIETY OF LONDON, at 5 30 —Prof O T Jones The History of the Yellowstone Cañon Yellowstone National Park U S.A (Lecture)

INSTITUTE OF METALS (Swansea Local Section) (at Thomas Cafe Swansea) at 7 —G E K Blythe Pulverised Coal in Metallurgy

INSTITUTE OF FUEL —H A S Gothard The Application of Pulverised Fuel Firing for Lancashire Boilers

THURSDAY JANUARY 10

ROYAL SOCIETY OF ARTS, at 3 —Capt. Sir Arthur Clarke Ships and Lighthouses (Dr Mann Juvenile Lectures) (II).

INSTITUTION OF ELECTRICAL ENGINEERS at 6 —Capt J M Donaldson Capt J G Hines and others General Discussion on A Study of the Future Development of Demand and the Economic Selection Provision and Layout of Plant, as illustrated by Telephone Systems on the one hand and Power Systems on the other

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Colour Group) at 7 —F R. Newens Demonstration of Flashlight in Colour Photography and the Desensitising and Development of the Agfa Colour Plate

LITTLEBOROUGH TEXTILE SOCIETY (at Central Council School Littleborough) at 7 30 —H Sotcliffe Some Power Transmission Problems

INSTITUTE OF METALS (London Local Section) (at 83 Pall Mall) at 7 30 —H C Lancaster The Lead Industry

OIL AND COLOUR CHEMISTS ASSOCIATION (30 Russell Square), at 7 30 —B. Campbell Nitro-cellulose Lacquers

INSTITUTION OF MECHANICAL ENGINEERS (Glasgow Branch).

INSTITUTE OF CHEMISTRY (Manchester Section) (at Manchester).—H D K Drew Pregl's Micro-methods of Analysis.

FRIDAY, JANUARY 11

ROYAL ASTRONOMICAL SOCIETY, at 5

PHILOLOGICAL SOCIETY (at University College), at 5.30 —L. C Wharton Dialect Developments.

MALACOLOGICAL SOCIETY OF LONDON (in Zoological Department, University College), at 6

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (in Mining Institute, Newcastle upon Tyne), at 6 —W J Drummond Coal used in its Raw State —Dr W T K. Braunholz Fuels obtained by the Treatment of Coal

INSTITUTION OF ELECTRICAL ENGINEERS (London Students Section), at 6 15.—J A. H Lloyd Telephone Repeaters.

BLACKBURN TEXTILE SOCIETY (at Blackburn Technical College), at 7 30.—Dr P Bean The Dyeing of Artificial Silk

KEIGHLEY TEXTILE SOCIETY (at Kiosk Café Keighley), at 7 30.—Lecture on Artificial Silk

OIL AND COLOUR CHEMISTS ASSOCIATION (Manchester Section) (at Milton Hall, Manchester), at 7 30 —Dr J J Fox The Examination of Paints

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section).—N S Humphries The Efficiency of the Present-day Finishing Stenter

SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group).—Prof B P Haigh The Relative Safeties of Mild and High Tensile Alloyed Steels under Alternating and Pulsating Stresses.

EXHIBITION

TUESDAY WEDNESDAY AND THURSDAY JANUARY 8 9 AND 10.

PHYSICAL SOCIETY AND OPTICAL SOCIETY (at Imperial College of Science). —Exhibition of Scientific Instruments —Discourses during the Exhibition at 8 each evening —

On Jan 8 —Prof F Lloyd Hopwood Experiments with High Frequency Sound Waves

On Jan. 9 —C Beck Lenses

On Jan. 10 —A J Bull Some Colour Problems in Photo-Engraving

PUBLIC LECTURE

TUESDAY JANUARY 8.

UNIVERSITY OF LEEDS (in Philosophical Hall Leeds) at 6 —O E. Simmonds The Wonders of Flying

CONGRESSES

JANUARY 4

CONFERENCE OF EDUCATIONAL ASSOCIATIONS (at University College)

Friday Jan. 4 at 11 A.M —British Broadcasting Corporation —Demonstration of Educational Broadcasting

At 2 30 —Medical Officers of Schools Association —Dr A. A Mumford Physical Activity and Physical Training in Relation to Scholastic and University Progress

JANUARY 4 AND 5

GEOGRAPHICAL ASSOCIATION (at London School of Economics).

Friday Jan 4 at 10 A M —E J Orford and others Discussion on Educational Re organisation and the Teaching of Geography

At 11 45 A M Sir H G Lyons The Geographer and his Material (Presidential Address).

At 2.30 —Prof C B Fawcett The Balance of Urban and Rural Populations.

Saturday Jan 5 at 10 30 A.M —Dr Vaughan Cornish On Linguistic Frontiers in Central Europe dating from Heathen Times

At 11 45 A.M —Hon Secretary Summary of the Results of Discussions held on the previous days

JANUARY 4 AND 5

NORTH OF ENGLAND EDUCATION CONFERENCE (at Heaton Secondary Schools Newcastle upon Tyne)

Friday Jan 4 at 10 A M —A R Pickles and others Free Place Examinations

At 11 15 A.M. —Miss I Jowitt and others Social Activities in Education

At 2 45 —A Watson and others Education in Relation to Industry and Commerce

Saturday Jan 5 at 10 A M —F A Hoare and others The League of Nations and the Schools

JANUARY 7 AND 8

MATHEMATICAL ASSOCIATION (Annual Meeting) (at London Day Training College).

Monday Jan 7

At 4 —H G Forder The Axioms of Geometry

At 5 30 —Prof H M Levy Modern Mathematical Problems in Aerodynamics

Tuesday Jan 8

At 10 A M —Miss E R. Gwatkin and others Discussion on Should a Candidate for School Certificate be allowed to take in place of the Mathematics and Science Group a Group containing Drawing and Music and possibly other Subjects?

At 11 4 —N J Chignell The Use and Abuse of Formulæ.

At 2.30 —Dr W F Sheppard Variety of Method in the Teaching of Arithmetic

At 3 45 —Prof J E A Steggall Methods of Voting in Theory and in Practice

Editorial and Publishing Offices

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SATURDAY, JANUARY 12, 1928

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Mr Ormsby-Gore and Tropical Development

THE attributes of a true research worker are high intellectual endowment a desire for knowledge a capacity for accurate observation and selection of relevant facts and data a mind unbiased by preconceived ideas, sound judgment, and breadth of vision We rarely associate such a combination of qualities with our politicians Special pleading is the enemy of truth Occasionally however, even a politician may free himself from the shackles of political expediency, and put the general interest before self interest mankind before country, and country before party To distil the essential wisdom from the heterogeneous ingredients of party controversy requires the courage of statesmanship the penalty of which is not infrequently loss of office and political oblivion For office is a party spoil

These reflections savour of the platitudinous but they are occasioned by reading the remarkable report (Cmd 3235, London H M Stationery Office) on his visit to Malaya Ceylon, and Java which the Parliamentary Under Secretary of State for the Colonies, Mr Ormsby Gore, has just completed for presentation to Parliament This is the fourth report of its kind based on personal visits for which Mr Ormsby Gore has been partly or solely responsible In 1922 he accompanied his predecessor in office (Mr Edward Wood now Lord Irwin) to the West Indies and British Guiana Two years later, Mr J H Thomas then Colonial Secretary made him chairman of the Parliamentary Commission which visited East and Central Africa, and in 1926 he made a tour of the four British Colonies in West Africa In the course of these tours alone, therefore, he has formed direct personal contact with the most of the dependencies the affairs of which fall within the scope of his ministerial responsibility His personal acquaintance with the countries of the Empire does not end there, however Before the War he visited South Africa and Rhodesia and during the War he served in Egypt, later as intelligence officer in the Arab Bureau, and finally as Assistant Political Officer in Palestine Probably no other minister has been able to bring to bear upon his task such comprehensive first hand acquaintance with our non self governing dependencies and the mandated territories for which we are responsible

Had such tours been made solely with the object of obtaining first hand information for facilitating Mr Ormsby-Gore's own work at the Colonial

Office, they would have been amply justified Fortunately, he has a wider conception of his responsibilities The knowledge he has gained he puts at the disposal of us all He tells us freely what opinions he has formed, what modifications in policy he would advise He gives us facts with strict impartiality He expresses his opinions with no attempt at dexterous ambiguity, and certainly with no air of infallibility On the contrary, he invites criticism, having first provided us with the necessary knowledge upon which to base it These are the methods of the research worker, the methods which make for progress They are certainly the only methods which will ensure that colonial development will proceed on right lines

In each successive report on British colonies, Mr Ormsby Gore has advanced his claim to be considered a research worker, not, it is true, as an original investigator in a specialised branch of science, but in the wide and complex fields of human relationships and the relation of man to his environment In these four reports on the colonies are set out with admirable clarity, completeness, and in due perspective, the multiplicity of problems confronting our colonial governments, together with what has been done towards their solution and what still remains to be done, what could have been done had our existing knowledge been properly brought to bear upon them, and problems which are likely to make the greatest demands on our research workers Considered as a comprehensive whole, these reports constitute a great achievement They can, with sincerity and truth, be described as a monumental and magnificent research

In the introduction to his report on Malaya, Ceylon, and Java, the occasion of this review, Mr Ormsby Gore reminds us that " British possessions in the tropics are at widely different stages of development, but each and all have many problems in common, and each has something to learn from the experience and practice of others " Accordingly, in this, as in previous reports, he concentrates on particular features , for example, the state of agriculture and animal husbandry, public health, education, forestry, and transport, hoping that their study by the comparative method may reveal facts and suggestions which may prove useful to other colonies A separate chapter is devoted to rubber , first, because it is the principal economic crop of Malaya , and, secondly, to comment on the results of the Stevenson scheme of restriction of output of this commodity All these subjects possess a special interest for scientific workers, and in dealing with each of them Mr Ormsby Gore lays stress on the contributions which science has made or can be expected to make to the development of the services or industries with which they are related

Not the least valuable parts of the report are those dealing with geographical, historical, and economic facts relating to the colonies They cannot fail to interest anyone with the slightest desire for knowledge of conditions of tropical life They are presented also in such a way as to fix outstanding facts in our minds British Malaya, we are told, covers a total area a little less than that of England Its total population is to-day probably about four millions The Dutch Colony of Java, climatically resembling British Malaya, covering a smaller area, contains a slightly larger population than England, although most of the Javanese (the Handbook of the Netherlands East Indies gives the proportion as more than 70 per cent) are engaged in farming Practically the whole of Java is under cultivation, whereas the greater part of the Malay peninsula is still virgin forest, and a large proportion of the food supplies for its inhabitants has to be imported Yet, although the population density of Java is eleven times, and its actual population nearly ten times, that of British Malaya, its overseas trade is less than that of the British colony For 1926 the imports of British Malaya were valued at £117,000,000, and the overseas exports at £147,000,000, the corresponding figures for Java being £72,000,000 and £131,000,000, all figures being exclusive of bullion and specie " These remarkable totals [for British Malaya] exceed those of the total external trade of the whole of the rest of the Colonial dependencies put together The value of exports per head of the population of British Malaya for the last two years has exceeded that of any other country in the world, and is higher even than the figure for New Zealand, which leads the self-governing Dominions in this respect "

Tin and rubber are the two factors determining this result for Malaya " In 1927 nearly half the world's tin supply was mined in Malaya, and about 70 per cent of the supply of refined tin was shipped from the smelting works in Singapore and Penang " The net export of crude plantation rubber from Malaya in 1927 was 240,000 tons, representing more than 42 per cent of the total exports of rubber-producing countries Soil fertility is the main factor determining the high population density of Java The mountain region in Java consists entirely of volcanic rocks which disintegrate

rapidly in the warm, humid climate, and thereby enrich the soil There are other contributory factors to be taken into account The pirates of the Straits may have for centuries deflected Indian and Arab traders and settlers from Malaya to Java, while the efficiency of the Dutch colonial scientific and technical services in Java has resulted in vastly increased yields per acre and facilitated population increase "The island of Java," says Mr Ormsby Gore, "affords the most remarkable example in the world to day of the application of science to the development of the tropics" Obviously, neither piracy nor science can have been of great importance in comparison with the natural fertility of the soil in the determination of Java's high population density If they had been, we should expect Sumatra to have a much higher density of population than British Malaya, whereas it is only slightly higher

Nevertheless what the Dutch have accomplished in Java by the application of science should provide much food for thought for all our colonial governments, and even India The yield of rice per acre in Java is a little more than double that of British India Last year (1928) Java expected to produce nearly three million tons of sugar from less than half a million acres of land Since the establishment of the sugar industry in Java, about the middle of the last century, the yield per acre has been increased sixfold Java is now the highest sugar producer per acre in the world, and owes its position to the application of plant genetics and soil science The success of the cinchona (quinine) industry, a virtual monopoly in which is held by Java and Sumatra, has been due almost entirely to very strict scientific controls The problems presented to the Irrigation Department in Java are some of the most difficult that have ever been presented to hydraulic engineers, Mr Ormsby Gore informs us but they appear to have solved most of them As an investment it [the Irrigation Department] has repaid the Dutch East Indies very handsomely, and assuredly it is an outstanding example of the benefits which western science and technical skill can offer" In Buitenzorg, in Java, there are the famous tropical plant research station and a number of other institutions with which more than a hundred scientific workers are associated

All research for the Dutch East Indies, however, is not centralised in the government research institute at Buitenzorg The plan of special research institutes, the activities of which are centred in a particular crop, as advocated and put into effect by the Howards in India, has been in existence for a number of years in Java "The pivot of the sugar industry in Java is the great sugar research station at Pasoerean in East Java," the finest of its kind in the tropics It has been supported entirely by the industry from its inception Six other separate agricultural research stations, 'proef stations" as they are called, are maintained by the Algemeen handbouw Syndicaat' or General Planters' Association, entirely by private subscription and voluntary levies There are a Tea Research Station at Buitenzorg staffed by nine European scientific workers, a Rubber Research Institute also at Buitenzorg, also with nine workers, a coffee 'proof' station at Malang in East Java with eight, the Besoeki Proof Station at Djember, East Java for tobacco, rubber, and coffee, with five Europeans, a quinine station at Tjinjiroean, in the Preanger Highlands, West Java, and a small general proof station at Salatiga, near Samarang, Central Java

Having been given the opportunity to make himself personally acquainted with the work of the Dutch administration and Dutch scientific workers in Java, noting that the greatest advances in the rubber-planting industry have been made by the United States Rubber Plantations and the A V R O S Rubber Experimental Station in Sumatra, that Malaya has a handicap of ten years to make up in the scientific study of budgrafting and related problems of the rubber industry, that "the share of Malaya and Ceylon in total world exports of crude plantation rubber has fallen from 70 per cent in 1922 to 52 per cent in 1927, while the Dutch East Indies have increased their share from 25 per cent in 1922 to over 40 per cent in 1927," that "Malaya is behind Java in the use of wireless telegraphy and telephony, and its ordinary telephone system is not nearly so complete or far reaching" Mr Ormsby Gore finds the cause in the British administration services His attitude is reflected in the following comment on the recruitment of administrative officers for these colonies The examination seems still to attract in the main those who have specialised at the University in classics or pure mathematics In the tropics, especially in tropical areas in process of rapid economic development, sound basic knowledge of natural science, biology as well as physics and chemistry, is of ever increasing significance The administrative officer has to fit in and co operate with a large variety of technical officers, and . he should have some idea of the nature of the problems which confront the latter, who often looks upon him as a member of senior and pivotal service"

Neurology and Psychology

Brain and Mind or the Nervous System of Man By Prof R J A Berry Pp xii + 608 (New York The Macmillan Co, 1928) 31s 6d net

IN the opening chapter of this interesting book is introduced the main theme of the whole volume the neuronic arc is the basis of all nervous activity, whether the simple purposive reflex or even the human cerebral processes associated with thought, memory, and reasoning Neuronic arcs are formed by chains of neurones or nerve cells functionally connected by synapses The neurone is therefore the unit of nervous activity This theme dominates the whole book, and it is in entire agreement with experimental findings

For more than four hundred pages the morphology and development of the nervous system is dealt with in a systematic manner Since this part of the book closely resembles most books on the anatomy of the nervous system, there is no need to consider it in detail We doubt the utility of the continual publication, in books of this type, of much of the detailed anatomy of those parts of the nervous system concerning the function of which we are almost entirely ignorant, for it seems to cause a rather large break in the real matter in hand There are numerous diagrams, some of which are very illustrative, and also short accounts of the physiology of the various parts described

Unfortunately, Prof Berry has not taken sufficient account of the more recent advances in the physiological knowledge of the nervous system This is particularly evident in his chapter on the nerve impulse, where one finds his use of the term 'nerve energy' very vague and somewhat misleading With our present conceptions of the physiology of the nervous system, such a term is better not used at all We notice with approval that the histology of the cerebral cortex is dealt with clearly and fully Prominence is given to the division by Watson of the cerebral cortex into three layers—infragranular, granular, and supragranular The infragranular cortex is stated to be the brain of the animal and sexual instincts, the granular of reception and storage of impulses, and the supragranular of control, inhibition, and reason While Bolton and Watson have adduced much evidence in support of this, we regard it as by no means proved, and, especially in the association areas, it seems possible that all parts of the cortex are concerned in the higher cerebral functions of control and reason This division of the brain into layers of different function is perhaps no more absolute than the older division of it into functionally distinct areas

In this and other places it is regrettable that Prof Berry does not distinguish more clearly between facts and theories The assignment of the function of 'storage of receptor impulses,' *i e* the basis of memory, to the neurones of the granular layer is interesting, but requires experimental support Prof Berry does not tell us how this storage occurs, and the idea seems opposed to our physiological knowledge The usually accepted theory of memory is that a modification in the so-called synaptic resistance is produced by the passage of impulses, and this change may be of long duration if sufficiently intense This can scarcely be termed a 'storage of impulses' There are also speculations on the functions of other cells of the cortex It is interesting to see the correlation of the developmental thickening of the cortex, and especially the myelination of the white matter with the data of Berry and Porteous on the increase in the cerebral capacity of the living child

In the second part of the volume, Prof Berry attacks the problem of the correlation of the morphology of the cerebral cortex with psychology We agree with his insistence that psychology should be considered in relation to the structure of the brain, but we are not convinced that this has been successfully accomplished For success to be attained, a much more precise knowledge of the detailed structure and function of the cortex is necessary, and that can only be obtained by years of patient research The work of Pavlov on the cortex is of especial importance, yet it finds but scant mention in this book Until our physiological knowledge is greatly added to, structure can be of little assistance in the elucidation of psychic processes The difficulties are brought before us by the obscurities of many of the passages in some parts of this section

On the psychological side Prof Berry reminds one somewhat of McDougall, and his criticism of Freud is healthy and stimulating For the most part it is just sound common-sense correlated with neurological knowledge There is no doubt that we must agree with Prof Berry's main theme—no neurone, no mind—and it is also certain that the individual who possesses less than a certain number of cortical neurones cannot be expected to be normal in behaviour We are not convinced, however, that one can go further than this and say that intelligence is proportional to the number of cortical neurones As yet, our knowledge of the functioning of the cortical neurones is not precise

enough to allow of anything except vague suggestions regarding their behaviour in mental processes, and, until our knowledge is more profound, mere numerical value is an unknown factor As Prof Berry himself states, the data from histological examination of cerebral cortices and from head measurement are only definite in extreme cases One must bear in mind all those finer gradations in conduction from one neurone to another in the spinal cord, as found by Sherrington and others, and consider the possibility that in the cortex the gradations are even more delicate and more variable In such a comparatively simple region of the nervous system as the spinal cord, it would be absolutely impossible to form any idea of the peculiarities of the reflexes elicited from it after the most careful macroscopic and microscopic examination One must realise how crude our technique is The index of chromatolysis on which the author places emphasis is by no means certain in interpretation It seems unlikely that Nissl bodies are the source of the so called nerve energy, most likely they are reserve food in the neurone

Taking into account all these extreme difficulties, for there is no doubt that the human cerebral cortex is the most difficult problem man will ever face, one cannot help feeling that Prof Berry has done well to get, in these days, so far as he has In those interesting series of tests for mentally deficients, he has given us something of real value, for the high grade ament is a very serious menace to society, and his early detection and control a matter of the greatest moment The author's large experience of more than 15,000 cases places him in a position to speak authoritatively on that subject He lays due stress on the fact that, while brain capacity is a useful test, it must only be used as an aid to diagnosis in combination with other tests It is only after the application of all the tests described by the author that any attempt at diagnosis can be made

A careful perusal of this part of the book makes one aware of the difficulties of diagnosis which must occur in many cases, and the imperative need for a special training in the subject The majority of the medical profession are sadly unfamiliar with the diagnostic methods for high-grade amentia The importance of a diagnosis is stressed by Prof Berry, for investigations have shown that a large proportion of criminals and other anti social individuals are made up of high-grade aments In other high grade aments there is the development of various neuroses and psychoses due to an incompetent brain being unable to cope with the stresses of modern life The early diagnosis of high-grade amentia would enable the individual to be brought up in a suitable environment to the advantage both of himself and of the community We can only wish that medical men, social workers, and educationists were familiar with the problem presented to society by the existence of high-grade amentia, and, above all, with the methods of attacking that problem We cannot do better than to recommend them to read at least the last few chapters of this interesting book

A more complete bibliography and more numerous references in the text would be an improvement Some useful reference tables and a good index complete this attractively published volume

J C ECCLES

The Works of Roger Bacon

(1) *Opera hactenus inedita Rogeri Baconi Fasciculus VI Compotus Fratris Rogeri, accedunt Compotus Roberti Grossecapitis Lincolniensis Episcopi, Massa Compoti Alexandri de Villa Dei*, nunc primum edidit Robert Steele Pp xxviii +302 1926 *Fasciculus VII Questiones supra Undecimum Prime Philosophie Aristotelis*, nunc primum edidit Robert Steele collaborante Ferdinand M Delorme, O F M Pp xii + 160 1926 *Fasciculus VIII Questiones supra libros quatuor Physicorum Aristotelis*, nunc primum edidit Ferdinand M Delorme O F M collaborante Robert Steele Pp xxii + 284 1928 *Fasciculus IX De Retardatione Accidentium Senectutis cum aliis opusculis de rebus medicinalibus*, nunc primum ediderunt A G Little, E T Withington Pp xliv + 224 1928 (Oxford Clarendon Press, London Oxford University Press)

(2) *The Opus Majus of Roger Bacon* By Roger Bacon A Translation by Robert Belle Burke Vol 1 Pp xiii + 418 + 4 plates Vol 2 Pp vi + 419 840 + 4 plates (Philadelphia University of Philadelphia Press, London Oxford University Press, 1928) 42*s* net

THERE has recently appeared a whole series of important works on Roger Bacon Since 1926, four parts of the "Opera hactenus inedita Rogeri Baconi" have been issued from the Clarendon Press, and now an English translation of the "Opus Majus" appears, in two large tomes, from the University of Pennsylvania The time is approaching when we shall be able to form a balanced judgment of Roger from a survey of all his works In the meantime we must be content to consider these works separately

(1) Mr Robert Steele is responsible, in part or in whole, for three out of the four volumes which the authorities of the Clarendon Press euphemistically describe as 'Fasciculi' The smallest of these diminutive works contains some 170 closely printed pages The largest can only be completely studied by those who survive to the three hundred and thirtieth page 'There were giants in those days' Something more than ordinary enthusiasm is needed to sustain a man through years of such heroic labour as the preparation of these volumes implies Mr Steele has a standing in work of this kind that places him above criticism We shall content ourselves by placing before the reader some abstract of the results of his labours and of those of his colleagues

Fasciculus VI deals with the "Compotus" of Roger "Compotus" is the science by which time is reckoned The need of such studies arose from the difficulty of combining a lunar calendar with a solar, since the lunar month and solar year are incommensurable In the Middle Ages the matter assumed pressing importance, because of the stress laid on the fixation of the dates of the Church festivals, and notably of Easter A number of works were produced on the subject, among which that of Roger takes an important place Of it Mr Steele rightly says that

"The outstanding merit of this work, written at a time when Bacon was undoubtedly passing through a period of dejection, is that it forms a complete treatise on the calendar, it is a masterly exposition of what was known about the measurement of time at a period when astronomical observation with the naked eye had been pushed to its farthest point, and reduced to tables of great accuracy It gives also an account of the history of the subject much fuller than is to be found in any of the earlier authors, embodying the knowledge of its time Lastly, it is in itself a masterly and complete, though tacit, exposition of all the evidence against the assumptions of the ecclesiastical calendar, only towards the end of the treatise, when Bacon has summed up, does he allow himself to give free vent to a criticism where more cautious writers had been silent"

Fasciculus VII is produced by Father Delorme in collaboration with Mr Steele It consists of Roger's lecture notes on the book which we now describe as the twelfth—not eleventh, as Roger calls it—of the "Metaphysica" of Aristotle A study of it had been incorporated by the late Prof Duhem in his magnificent treatise, "Le Système du monde" Book XII of the "Metaphysica" is not of importance for the history of science, and the main interest of Roger's work on it is the evidence that it provides for the sources of his knowledge It is well known that in his day the chief versions of Aristotle available had been rendered from the Arabic The book shows, however, that Roger relied also on a very ancient version of Aristotle's "Metaphysica," rendered from the Greek This is a point of more importance for the history of thought than might at first be supposed

Fasciculus VIII is also the joint product of MM Delorme and Steele, and shows that for the "Physics," as for the "Metaphysics," Roger was using an ancient translation direct from the Greek The treatise does not increase our estimate of Roger as an exponent of the experimental method, though it is of importance for the history of medieval philosophy It must be remembered that the "Physics" of Aristotle scarcely deals with that subject as now understood, but with theoretical considerations that received no experimental proof

Fasciculus IX is the joint production of Mr A G Little and Dr Withington, and deals with the medical treatises It is prefaced by a valuable introduction There is no doubt of the importance of these treatises to the student of medieval thought, but we look for something higher from Roger Here is his editor's estimate of these works

"We must admit that the Epistle and treatises on old age are a grievous disappointment They show close dependence on authorities he might have known were at best second hand, a simple faith in the marvellous power of remedies, most of which had been used for centuries with no remarkable results, and sometimes a pretence of secret knowledge which reminds us painfully of the alchemic quacks

"Perhaps the best that can be said is that within twenty years of Roger's death, the greatest physician of the age, Arnald of Villanova, might have been seen diligently perusing one of these treatises, the *Liber de Conservatione Juventutis*, and working it up into another treatise which he then dedicated as an original work to King Robert the Wise of Naples and Jerusalem"

Nevertheless, one of the treatises here printed ("De erroribus medicorum") contains perhaps the most forceful statement that Roger has made as to the nature of the experimental method It may be translated thus

"Since science is sure knowledge of truth, and since argument clinches truth but does not exclude doubt, no certitude is produced thereby till experience is added And anyone finds this to be so in countless matters

"Thus though the first proposition of Euclid is most powerfully demonstrated when it is said that all lines from the centre to a circumference are

equal, and that each side of a triangle constructed on a given line has that relation to it, and they are therefore equal to one another, the mind of the hearer does not come to rest in the truth till he have experience of the figure of two intersecting circles, with two lines drawn from the point of intersection to the ends of the given line, and not even then does he have absolute assurance unless he goes on to get definite experience by measurement

"So, however much one should prove by argument to one without experience that a magnet attracts iron, and that such attraction would be possible in Nature, yet the man would never get assurance of it without experience For we neither care so much for authority nor for reasoning *ad hoc* as for experience, and then the mind comes to rest"

(2) Undoubtedly the most important work of Roger is the "Opus Majus," on which, more than any other, his reputation is based It is too much to hope—or at least it is too much to believe—that many will read the entire works of Bacon in their original Latin But, despite modern detraction, Roger does take an important place in the history of philosophy, and it is therefore important that his leading work should be translated into English Mr Burke has, on the whole, done his work well The scientific reader may rely upon the general sense of his version There are indications that in places he is less acquainted with medieval usage than Mr Steele and his collaborators in the "Opera hactenus inedita" That standard, however, is a very high one, and the 'book' is, in any event, an extremely useful addition to the library of the history of science

Roger was a medieval, and his best points are buried in a mass of verbiage Lest the reader miss his fine statement of the nature of the experimental method, with which he introduces Part VI, we here quote it

"Having laid down fundamental principles of the wisdom of the Latins so far as they are found in language, mathematics, and optics, I now wish to unfold the principles of experimental science, since without experience nothing can be sufficiently known For there are two modes of acquiring knowledge, namely, by reasoning and experience Reasoning draws a conclusion and makes us grant the conclusion, but does not make the conclusion certain, nor does it remove doubt so that the mind may rest on the intuition of truth, unless the mind discovers it by the path of experience, since many have the arguments relating to what can be known, but because they lack experience they neglect the arguments, and neither avoid what is harmful nor follow what is good For if a man who has never seen fire should prove by adequate reasoning that fire burns and injures things and destroys them, his mind would not be satisfied thereby, nor would he avoid fire until he placed his hand or some combustible substance in the fire, so that he might prove by experience that which reasoning taught But when he has had actual experience of combustion his mind is made certain and rests in the full light of truth Therefore reasoning does not suffice, but experience does"

CHARLES SINGER

Preservation of Animal Remains

Rezente Wirbeltierleichen und ihre paläobiologische Bedeutung Von Prof Dr Johannes Weigelt Pp xvi + 227 + 38 Tafeln (Leipzig Max Weg, 1927) 24 gold marks

HUGH MILLER, viewing the hundreds of complete fossil fish which lay on a single bedding plane of the Old Red Sandstone, speculated on the causes which had led to so vast an accumulation, and on the repetition of this phenomenon at intervals throughout this series of rocks The problem he then propounded is still unsolved, and to it have been added those which are presented by the bone beds in the Pontian of Pikermi and in many other horizons and localities

It is most difficult for any geologist whose experience of the world does not extend beyond western Europe to conceive any conditions under which such masses of dead fish or dead mammals can have been brought together Even the literature of geology gives little help Thus Prof Weigelt's excellent book should prove most stimulating to geologists, and especially to those vertebrate palæontologists who have to determine, as all must for their own satisfaction even if they do not publish their speculations, the conditions under which the animals with whose remains they are dealing lived

Prof Weigelt gives an account of all those changes which go on in the body of a vertebrate after death, and explains the events which may produce a carcase like those which are preserved as the Trachodon mummies He then discusses those causes of death which are likely to affect large numbers of individuals at the same time, or to bring single creatures into positions where their remains have an exceptionally favourable chance of being preserved He records death through volcanic activity, poisonous gases, prairie and forest fires, drowning, being mired in mud or quicksand, by floods, hunger and thirst, by hunters both human and other, by ice, snow, and mere cold The last is illustrated by a remarkable case at "Smithers Lake" in south-west Texas This shallow lake, 1500 acres in extent, is partly artificial, a dam

having caused it to spread over a forested area, killing all the trees, their stumps remain *in situ*, and their twigs and branches are carried about by currents. On Dec 18, 1924, the air temperature in this locality had a maximum of 80° F and a minimum of 68° F, next day the maximum was 68° F and the minimum 23° F, whilst on the two succeeding days the temperature never exceeded the freezing point. This frost killed thousands of alligators, tortoises, and gar fish (*Lepidosteus*). In the February and March following the bodies of these animals had been collected into one area by currents and there lay in shallow water, which afterwards dried up. Prof Weigelt publishes many excellent photographs of these victims which afford most accurate parallels to the appearances shown in fossil ganoid fish.

The numerous plates which illustrate the book will bring vividly before the reader conditions which are familiar to all who have travelled in arid regions but are scarcely appreciated by those who have not enjoyed such an experience.

The book should prove interesting to zoologists in general, as well as to those palæontologists to whom it is specially addressed.

D M S WATSON

Euclidean Geometry

The Foundations of Euclidean Geometry By Henry George Forder. Pp xii + 349. (Cambridge At the University Press, 1927.) 25s net.

IT is interesting to compare the attitudes of the two most recent writers in English who deal with Euclidean geometry. Sir Thomas Heath, in the second edition of his three volume translation of the "Elements" (Cambridge, 1926), reiterates his opinion that Euclid "remains the greatest elementary text book in mathematics that the world is privileged to possess", Mr Forder, in the book under review, emphasises the fact that "many flaws have been noticed in his treatment during the two thousand years that have elapsed since his work was written." The two points of view are, of course, not in the least contradictory. Indeed, Sir Thomas Heath is careful to point out that "much valuable work has been done on the continent in the investigation of the first principles, including the formulation and classification of axioms or postulates which are necessary to make good the deficiencies of Euclid's own explicit postulates and axioms," and not the least valuable part of his great work consists in his notes and commentaries on research on the axiomatic side. Mr Forder is mainly concerned with foundations, and his book will go far to remove the reproach implied in the words "on the continent" in the passage quoted. Having laid down his foundations, he goes on to erect his edifice of elementary geometry, remarking that "scarcely one proof in any school text will survive a critical examination." Sir Thomas Heath would probably agree (cf his original preface, loc cit, vol 1, pp v vi).

It is somewhat remarkable that no one before had written a "connected and rigorous" account of Euclidean geometry comparable with Veblen and Young on projective geometry, the gap needed filling up, and Mr Forder has done it admirably. Naturally, the result makes somewhat heavy reading, and the temptation to ignore the advice "to make sure that the full formal proof can be given" in each case is very strong. Still, the numerous 'notes,' in smaller type and less formal phraseology, help to lighten the way along.

We begin with axioms of order, a three termed relation between points, and work up to definitions of the line, the plane, and the space. (In parenthesis, may we ask whether it was really necessary to introduce the horrible verbs 'to colline' and 'to coplane,' and to abbreviate 'Theorems' into 'Thes'?) The next chapter uses these axioms to develop theorems on angles and order relations between rays from the same point. Then come axioms of congruence. It is interesting to compare the author's blunt dismissal of the method of superposition, "this vicious method" (p 91), with Sir Thomas Heath's more courteous historical treatment (loc cit, vol 1, pp 225 ff). We are next given applications to the properties of circles and spheres which do not depend on the parallel axiom, a new axiom concerning the intersection of two circles is necessary, and this in turn enables us to drop certain of the congruence axioms previously used.

Chap vi deals with parallel axioms, which distinguish Euclidean geometry from other geometries with congruence theories, various forms, differing in strength, are given and discussed, with applications to parallelograms and a digression on projective geometry. The author then proceeds, on the basis laid down, to develop a theory of proportion, to prove Pythagoras's theorem in a form in which there is no question of areas, to introduce co ordinates and to consider constructions possible with ruler and compasses, with some reference to Mascheroni's constructions with compasses alone. Still continuing on the same basis, we study the dissection of polygons into triangles,

and so are led to the areas of polygons and the volumes of polyhedra

In Chap xiii a return is made to axiomatics, an axiom of continuity is added, and it is shown how this enables us either to drop the congruence axioms or else to weaken the parallel axiom and drop some of the congruence axioms, both schemes suffice for Euclidean geometry and are consistent and complete By way of appendix we are given an outline of a different method of procedure in which congruence is taken as the only undefined relation between points, and finally an excursus on non-Euclidean geometries

We congratulate the author and the Cambridge University Press on an excellent piece of work

Our Bookshelf

(1) *Bolles Lee's Microtomist's Vade Mecum a Handbook of the Methods of Microscopic Anatomy* Ninth edition, edited by Prof J Brontë Gatenby and Dr E V Cowdry With the collaboration of Dr W R G Atkins, the late Prof Sir William Bayliss, J Thornton Carter, Dr Robert Chambers, Dr W Cramer, the late Dr C de Fano, Dr Helen Pixell Goodrich, Dr J G Greenfield, Dr Reginald Ludford, G Payling Wright, and Dr F W Rogers Brambell Pp x + 714 (London J and A Churchill, 1928) 30s net

(2) *Histological Technique a Guide for Use in a Laboratory Course in Histology* By Dr B F Kingsbury and Dr O A Johannsen Pp vii + 142 (New York John Wiley and Sons, Inc, London Chapman and Hall, Ltd, 1927) 11s net

(1) The new edition of this indispensable work has been enlarged, new sections have been added, some of the older matter has been omitted, and the names of new collaborators appear on the title-page Full accounts are given of the technique of tissue cultivation and of micro manipulation

More care in editing would remove a few inconsistencies we have noticed Thus a method for ripening hæmatoxylin solutions is described as having been "re invented lately," the reference given being dated '1912' Both the spellings 'methylen' and 'methylene-' blue occur in text and index, in the latter they are separated, and the pages referred to are for the most part distinct In fact, the all-important index would be the better for drastic revision, for as it stands it may be necessary to look up several headings to obtain the whole of the information on a particular subject A good instance of this is 'Acid Fuchsin' For full information on the uses of this dye several other headings must be consulted (*e g* Fuchsin, Acid, Saurefuchsin, Rubin S, etc), as the page references given under each are for the most part different, *i e* they are not cross references

(2) The second book is essentially a guide to the fundamental methods of normal and pathological histology as required by the medical and the biological student Fixation, sectioning, staining and mounting, the microscope, and special methods for blood, muscle, nerve, etc, are all dealt with, and a final section gives methods for the investigation of invertebrates in general The information appears to be adequate and accurate, and the book should serve the purpose for which it has been written

R T H

The Potato its History, Varieties, Culture and Diseases By Thomas P MacIntosh Pp xvi + 264 + 11 plates (London and Edinburgh Gurney and Jackson, 1927) 12s 6d net

Potatoes constitute one of the few foodstuffs in which Great Britain is still self supporting, and great advances have been made in recent years on various problems relating to their culture The growing menace of disease has directed attention to the classification and identification of the many varieties used in commerce, and, more recently, work in virus disease indicates a reason for the well known degeneration of stocks Questions of marketing and synonymous nomenclature are purposely omitted from this volume, but historical notes on the chief breeders and the varieties introduced by them are included

Perhaps more than with any other crop, it is essential for all workers with potatoes, from whatever aspect, to have a thorough knowledge of the many varieties, and special attention is therefore devoted to their classification and to details of intervarietal differences These are based on type varieties of the main groups, and the variations in different parts of the plant are clearly and comprehensively set forth and illustrated The tubers are classified in tabular form, based primarily on colour

Under modern methods of cultivation, potatoes are usually grown between two cereal crops to gain the full benefit of their cleaning value, and they are the best of all crops in their response to artificial fertilisers As food they are chiefly valued for their high carbohydrate content, the proteins usually being ignored, but care is needed if they are fed uncooked to livestock Industrially, they are widely used for alcohol production (giving a residual cattle food), potato starch and flour, dextrine, glucose, and for dried potatoes The danger of attack by plant and animal pests is naturally great in such a universally grown crop, and virus, fungus, and bacterial diseases call for the utmost efforts of pathological research workers Descriptive notes of some common commercial varieties, and a glossary of the more technical terms, conclude this most useful summing up of modern work on potatoes

The Fundamentals of Chemical Thermodynamics By Dr J A V Butler Part 1 *Elementary Theory and Applications* Pp xi + 207 (London Macmillan and Co, Ltd, 1928) 6s

The author believes that the student of chemistry should become acquainted with thermodynamical methods at an early stage, and his book affords an elementary introduction to the underlying

principles and their applications It demands little mathematical equipment and is chiefly concerned with cyclic processes All the nine chapters conclude with numerical examples to which, however, no answers are provided Nearly half the book deals with the applications of thermodynamics to electrochemistry, and in some cases the material has little relation to thermodynamics It is regrettable that the symbol δ has been used in place of the correct notation for partial differentiation On p 39 the transition point of rhombic to monoclinic sulphur is given as 95 5° C in the text and 96 5° C in the figure In the consideration of gaseous reactions in Chapter v, the law of mass action is deduced by using two equilibrium boxes This method of deduction does not correspond with any practical case and a better method is that used a few pages later for the maximum work, in which the problem is again worked out in detail and the external work term is introduced The book is clearly and carefully written, well printed, and is reasonably priced A second volume dealing with thermodynamical functions is promised

Some Questions of Musical Theory Chapter 3 The Second String, Chapter 4 Ptolemy's Tetrachords, With an Appendix The Tierce tone Scale By Dr Wilfrid Perrett Pp iv + 31 98 (Cambridge W Heffer and Sons, Ltd, 1928) 5s net

THIS is a continuation of the author's preceding chapters, "How Olympos found his New Scale" and "The Olympion," published in 1926 The first of the new chapters is a technical and historical discussion of the problem of the second string of the enharmonic tetrachord, and Dr Perrett directs attention to the fundamental difference between the ancient and the modern practice of harmony, the Greeks apparently having no instruments constructed to give very deep notes, and the singers forming their chorus being men, whose vocal enharmonic would have to be written in our bass clef The orchestration, mainly for harps and clarinets, must have been a light one, lying mainly above the voice part—more like what we should call an obligato

The second chapter gives a careful analysis of the tetrachords of Ptolemy and their relation to the Tablature Attention is naturally directed to the way in which we, accustomed to the Lydian mode, think of *the* scale as an uninterrupted series of eight notes, whereas the Greek musician looked upon the octave as composed of two descending series of four notes, two tetrachords separated by a "tone of disjunction" This view of the octave is still held in the Greek Church H D A

Myths and Legends of the Polynesians. By Johannes C Andersen Pp 512 + 48 plates (London, Bombay and Sydney George G Harrap and Co, Ltd, 1928) 21s net

IN his preface Mr Andersen admits that in the field of Polynesian mythology his personal gleaning has been small He came too late in the field He has accordingly availed himself freely of the work of Grey, of Percy Smith, and particularly of Elsdon Best, to name some only of those to whom he makes full acknowledgment His own contribution to this survey is a running commentary and an abstract of legends not cited in full, which makes his book a survey of and guide to Polynesian tradition, culture, and belief It is prefaced by a few general remarks on the physical character and languages and present conditions of the Polynesian which, brief as they are, give some background for the main theme of the book

The traditions of Polynesian migration receive due attention, as do the creation legends and those in which Maui figures The non specialist public, for whom presumably the book was written, will find in its stories much that is beautiful as well as strange, while the folklorist whose interest is general rather than specifically centred on Polynesia will appreciate its value as a guide to original sources of information

Progressive Trigonometry Part 1 *Numerical Trigonometry and Mensuration* By Frederick G W Brown Pp x + 222 (London Macmillan and Co, Ltd, 1928) 3s 6d

A PREVIOUS work of this author, "Higher Mathematics for Students of Engineering and Science," has already been favourably reviewed in these columns, and the present volume will supply a real want in the introduction of trigonometry at an early stage of the mathematical course Mensuration is naturally dealt with more fully than when this subject is merely included in a text book on arithmetic The simple solution of a triangle is well treated Throughout there are numerous examples of an interesting and practical character In the last chapter mention is made of spherical triangles

The book covers the syllabuses in mensuration and numerical trigonometry of most school examining bodies, and a second part is in preparation which will deal with the trigonometry required to the end of a school course The whole should prove very useful

Geology Manual an Instruction and Laboratory Manual for Beginners By Prof Richard M Field Part 1 *Physical Geology* Second edition Pp ix + 149 (Princeton Princeton University Press, London Oxford University Press, 1927) 12s 6d net

THE call for a second edition of this book within a year indicates that at least in the United States it has fulfilled a useful purpose Practical courses in geology in the universities of Great Britain probably stand less in need of such external assistance, but most teachers will find that they can adopt some of the Princeton methods with advantage

The new edition is enriched with sections on the chemistry of rock minerals and the essential characters of the sedimentary rocks, and there is a brief introduction to the study of economic geology The part of the book which deals with the interpretation of maps remains, as before, the best, though its appeal is necessarily to North America, except as regards the method of treatment

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications*]

The Transmission of Ultra-violet Light through Tracing Cloth

DURING an investigation of the effects of ultra violet light on various types of blue print paper, it was found that ultra violet light from a quartz mercury vapour lamp passed through ordinary commercial tracing cloth (or linen) to an extent both unexpected and surprising A number of tracing cloths were obtained, and spectrograms were taken with three seconds exposure using a Hilger quartz spectrograph

Specimens of various types of paper were also tested in a similar manner, and the results are shown in the photographs reproduced (Fig 1), and in the accompanying tables

TRACING CLOTHS

No	Type of Screen	Approximate thickness in mm	Mesh count per cm	U V Limit in Ångström units
	None			2225
A	Excelsior	0 070	44 × 44	2535 (faint)
B	Imperial	0 070	47 × 47	2535
C	Excelsior	0 083	47 × 47	2535 (faint)
D	Imperial	0 081	43 × 43	2482
E	Lion	0 080	41 × 41	2482

PAPERS

No	Type of Screen	Approximate thickness in mm	U V Limit in Ångström units
	None		2225
P	Newspaper	0 070	3984
Q	Kraft paper	0 101	4339 (faint)
R	Wrapping paper	0 077	3125
S	Writing paper	0 069	3125

Thickness and the number of meshes to the centimetre do not seem to have much importance, the material itself seems to be translucent to ultra violet

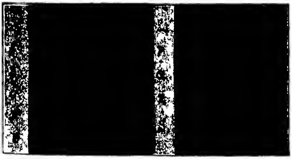

FIG 1

light On the other hand, experiments made with thermopile and galvanometer showed that the heat from the sun or from a red hot ball passed through the tracing cloth to a much less extent than through glass or vita glass

Herein may lie the usefulness of this discovery, because, whether in sunlight or in artificial ultra violet light, it is now possible to screen off much of the heat and yet retain most of the ultra violet A single layer of tracing cloth, between wide meshed wire screens, can now replace curtains or blinds, and with this screen before an *open* sunny window it is possible to enjoy the advantages of ultra violet light without undue heat or glare, although the eyes should be protected Moreover, for country cottages, chicken farms, etc , it is now possible to obtain a cheap and effective substitute for the many glasses which have been manufactured to secure ultra violet light in the more beneficial regions of the spectrum

C H YOUNG

McGill University,
Montreal, Nov 22

A New Band System of Carbon Monoxide

IN an attempt to photograph the so called spurious bands associated with the third positive carbon bands, on a 21 *ft* concave grating, my plates showed a band at λ3893 2 which was completely resolved under the dispersion I could also see some bands at λλ3681 1, 4125 0, and 4380 3 Good plates of these bands were obtained in the first order of the grating The band at λ3681 1 is completely mixed up with one of the spurious bands beginning at about λ3694, and those at λλ4125 0 and 4380 3 are to a more or less extent similarly mixed up with the Ångström bands at λλ4123 and 4393 respectively On the other hand, the band at λ3893 2 is completely isolated The fine structure analysis of this band was therefore easily achieved It has been possible also to analyse the fine structure of the bands at λλ4125 0 and 4380 3, since the structure of the superimposed Ångström bands is definitely known No attempt has yet been made to analyse the band at λ3681 1 as the structure of the spurious band superposing it is not known

It has been possible to arrange these bands as follows

n \ n	0	1	2	3
0	27168 0 (H) (3681 1) 27165 5 (*o*)[1]	25678 7 (H) (3893 2) 25686 2 (*o*)	24235 6 (H) (4125 0) 24243 1 (*o*)	22823 4 (H) (4380 3) 22830 8 (*o*)

[1] Calculated

The final state is thus identical with that of the Ångström bands Fine structure analysis proves the correctness of this arrangement, the (0 - 1), (0 - 2), and (0 - 3) bands having identical $F''(j+1) - F''(j)$ values with those for the respectively similar Ångström bands

Each band consists of one P, one R, and one Q branch, the latter being about twice as strong as either of the other two One R line and one Q line are missing, and the transition is clearly $^1S \longrightarrow {}^1P$, the latter level being identical with that of the Ångström system The initial level is about 5000 ν higher up than the initial level of the Ångström bands, and is thus identical with the new level at 91923 ν recorded by Birge (*Phys Rev*, **29**, 922, 1927) The new level is clearly shown by the present bands to be an ^1S level, and therefore the bands are very probably due to the transition $3^1S \longrightarrow 2^1P$, if the Ångström bands are $2^1S \longrightarrow 2^1P$

The fact that the new system has only one n'' progression is noteworthy The Ångström system has the $n' = 0$ progression well pronounced, but in addition possesses the first two members of the $n' = 1$ progression The third positive carbon bands and the

3A bands are also remarkable this way. The critical potential of the new bands is 0·62 volt higher than that of the Ångström bands, and is thus about 0·2 volt higher than that of the 3A bands. Hence it is not surprising that they consist of only the $n'=0$ progression.

The vibrational perturbation peculiar to the (0 – 0) and (1 – 0) Ångström bands seems to be also present in these bands. Though this is fairly certain, since the band at λ3681·1 is not analysed, this statement is only tentative.

It appears possible to identify with the above bands those recorded by Duffendack and Fox (*Astrophys. J.*, 65, 220; 1927). The three bands recorded by them as associated with the Ångström bands are λλ3679·5, 3894·8, and 4380·1. I feel justified in saying that these are the three of the four bands discussed in this letter. If I am correct, the 'legitimate' objection raised by them to the present analysis of the Ångström bands obviously disappears. Deslandres' band at λ3893, which Wolter could not obtain (*Z. wiss. Phot.*, 9, 361; 1911), is undoubtedly the band at λ3893·2.

I hope to publish a detailed account of this band system elsewhere. My sincere thanks are due to Dr. R. C. Johnson for helpful discussion.

RANGA K. ASUNDI.

Wheatstone Laboratory,
King's College, Nov. 19.

Striations in High Frequency Discharges.

IN the course of an investigation on the starting and maintenance potentials of the luminous column in argon, produced by applying a high frequency potential of wave-length from 10 to 300 metres to external sleeve electrodes, we found that steady striations were frequently developed. Using the method described by Townsend and Donaldson (*Phil. Mag.*, January 1928), an attempt was made to measure the potential fall over single striations to see whether any definite value could be assigned to it.

Steady striations have been observed at pressures ranging from the lowest pressure at which a discharge is obtainable to a pressure of about 10 mm. The most usual appearance of the striated discharge is that shown in Fig. 1. Fig. 2 shows the discharge in argon at the same pressure as in Fig. 1, but for a smaller distance between the electrodes. The luminous portions of the discharge sometimes have dark portions in the middle, giving them the dumb-bell appearance shown in Figs. 3 and 4. At pressures below 1/10 mm. the luminous portions become egg-shaped and have a clearly defined outline, as shown by the luminous portions at the ends of the discharge in Fig. 4. Fig. 5 is a photograph of the discharge under the same conditions as in Fig. 4, except that the distance between the electrodes is increased. The central part of the discharge has become a uniform glow, but a dark space can just be seen at each end of this glow, indicating that two more striations would have appeared had the electrodes been moved a little farther apart.

FIG. 1.—Pressure, 0·4 mm.; diameter of tube, 2·9 cm.; distance between electrodes, 11·5 cm.; λ = 80 metres.

FIG. 2.—Pressure, 0·4 mm.; diameter of tube, 2·9 cm.; distance between electrodes, 6 cm.; λ = 80 metres.

Striations have been obtained in discharges in argon in pyrex tubes 1·6 cm., 2·9 cm., and 3·9 cm. diameter for oscillations of wave-lengths 11, 40, 80, 160, and 320 metres. They are more easily produced when the longer wave-lengths and narrower discharge tubes are used. The distance between the electrodes when a given number of striations appear in the discharge is less in a narrow tube than in a wide one, as in the striated positive column of a continuous discharge. The lengths of the luminous portions increase as the pressure is lowered, and at low pressures each luminous portion gives rise to two egg-shaped striations. There are certain distances between the electrodes for which a whole number of striations is included, and the dark spaces are then very distinct. For intermediate distances which do not correspond to a whole number of striations, the dark spaces become almost indistinguishable and the luminous column almost uniform.

FIG. 3.—Pressure, 0·1 mm.; diameter of tube, 2·9 cm.; distance between electrodes, 17·4 cm.; λ = 80 metres.

When the potential difference between the sleeves is gradually decreased, and the minimum maintenance potential is approached, the glow usually becomes uniform. When the luminous column has the striated form, the potential required to maintain it is greater than when the glow is uniform. The striated form occurs more generally in argon than in helium and neon.

FIG. 4.—Pressure, 0·1 mm.; diameter of tube, 1·6 cm.; distance between electrodes, 10·5 cm.; λ = 80 metres.

Heidemann (*Ann. der Physik*, Band 85, Nr. 6, 1928) has recently described experiments on high frequency discharges in hydrogen and in argon, and records a striated discharge in hydrogen, but not in argon. From measurements that he has taken for internal electrodes in hydrogen, he concludes that the fall of potential per striation is constant under different conditions of pressure, but measurements with external electrodes varied from 15·6 to 18·4 volts. Some preliminary measurements of the fall of potential per striation in argon, using external electrodes, were made, and the values of the potentials obtained varied from 9 volts to 20·5 volts, the pressures ranging from 1·26 mm. to 0·14 mm. The method adopted was to measure the maintenance potentials when a given number of striations was included between the electrodes. The distance between the electrodes was then increased so as to include one, two, or three more striations, and the maintenance potential again measured.

FIG. 5.—Pressure, 0·1 mm.; diameter of tube, 1·6 cm.; distance between electrodes, 17·5 cm.; λ = 80 metres.

The following table gives the results for a wave-length of 80 metres and a tube 2·9 cm. in diameter, where V is the potential required to maintain four

striations, and V, the additional potential for each additional striation

Pressure	V_m	V
1 26	66 3	9
0 31	90·1	14 8
0 14	120	16 2

S P McCALLUM
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Critical Potentials of Light Elements for Simultaneous Transitions

INVESTIGATIONS have been made by various workers to determine the energy levels of the outer shells of the atom by bombarding it with cathode particles of definite velocity and measuring the photoelectric current due to the radiation impinging on a metallic plate Keeping the cathode current constant through the tube, the voltage is gradually increased, and it is found that at certain voltages kinks appear in the voltage-photoelectric curve These kinks are attributed to the sudden appearance of 'new types of radiation' and the corresponding voltages are called 'critical potentials'

Numerous observers (Richardson and Chahklin, Rollefson, Horton, Thomas, Compton, and others) have measured the critical potentials for the elements chromium to copper in the region from 40 to 200 volts, and in spite of certain disagreements between some of these values, due chiefly to the different values taken for W (the work necessary to remove the electron out of the metal) by different observers, it is found that there is a good agreement between them for about ten of these critical potentials, though these numbers are very much more than what is to be expected from the Bohr atomic model For example, Andrews, Davies, and Horton (*Proc Roy Soc*, vol 117) have obtained critical voltages for copper in this region corresponding to 56, 67, 75, 85, 116, 131, 153, 196, 212 volts, whereas from the Bohr model one would expect critical voltages at 76 9 (M_1, $M_{II} - M_{III}$) and 119 7 (M_1, M_I) only

Attempts have been made to explain the origin of the critical potentials by different observers, but none of them has been able to get the right result even qualitatively, though Richardson and Thomas have suggested the possibility of double ionisation in the atom

In a previous communication to NATURE (Nov 17, p 771) one of us (B B R) tried to account for the existence of secondary absorption edges by supposing that the same quantum of radiation can successively knock out two electrons occupying the same or different energy levels in an atom In a similar way we can explain the appearance of these critical potentials by assuming that in certain circumstances the same cathode particle can simultaneously eject two electrons either from the same or from different energy levels of the atom, and radiation is emitted due to simultaneous jumps of two electrons to fill up these two vacancies The frequency of the radiation then emitted is equal to the sum of the frequencies due to the individual jumps The idea of the emission of single quanta, as the result of the simultaneous transitions of more than one electron, has been already established in the field of optics (see Andrade, "The Structure of the Atom," pp 563 564)

With this idea we have plotted Moseley curves with $\sqrt{\nu/R}$ as ordinate against Z in the region from iron to copper for such transitions as $2M_1$, $2M_2$, $M_1 + M_2$, $M_1 + M_3$, $M_1 + (M_2 - M_3)$, $M_2 + (M_2 - M_3)$, and so on The values for M_1 and M_2 in this region are taken from X ray, and N_1 from the optical data, whereas M_3 is obtained by extrapolation On comparing the common values of different observers with those from the curve in these regions, we find that out of ten critical voltages, eight can be explained in this way, the error in any case is not more than 5 per cent The values for chromium and manganese can also be deduced with success from these curves by interpolation As for the other values, we are not sure if these are due to tungsten or to other impurities present in the metal We also wish to point out that a large number of lines would accompany each of the transitions considered here in accordance with the Pauli Hund rule as applied in the optical spectra

This hypothesis of simultaneous transitions thus appears able to explain satisfactorily a large mass of hitherto unexplained experimental determinations of critical voltages

B B RAY
R C MAJUMDER

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The Electromotive Behaviour of Single Metal Crystals

ALTHOUGH the results of crystal analysis indicate that the electromotive characteristics of a metal, in common with other properties conditioned by inter particle electrostatic forces, presumably vary with the orientation of the surface measured, no attempt seems to have been made to relate electrode potential measurements to a structure definitely describable in the crystallographic sense The study of this structure-potential relation seems particularly desirable if electromotive data are to be correlated with photo electric and electron condensation measurements The measurement of a definite cleavage plane of a typical single metal crystal suggests itself as a suitable starting point for such a study

Measurements in oxygen free solutions carried out at Yenching University, Peking, between June 1927 and June 1928 on three single zinc crystals, one of which was furnished by Prof Bridgman, indicate that the primary cleavage face (basal pinacoid) of a zinc crystal is capable of yielding potentials constant to within 0 0001 volt and reproducible to well within one millivolt The potential, further, was identical to that of the electrolytically deposited crystal conglomerate within the range of variation of duplicate conglomerate electrodes, a result which would be predicted if, as Bozorth (*Phys Rev*, 26, 390, 1925) has shown, the electrolytic crystals are deposited with a random orientation and if the potential of the primary cleavage is a unique maximum This second condition is rendered probable by the fact that the interplanar lattice distance is a maximum at the basal cleavage, but would depend upon any variation of the photo electric work function with orientation Attempts to prepare zinc crystals with naturally developed secondary faces sufficiently large for measurement have so far failed Measurements on artificially prepared surfaces annealed and lightly etched have seemed to indicate a qualitatively regular decrease of potential with increase of inclination to the primary cleavage plane This result is being checked by further work

It may be pointed out that the use of the single crystal electrode offers a possible solution of the problem of obtaining satisfactorily reproducible electrodes of the high melting-point, rigid lattice metals

PAUL A ANDERSON.

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Investigations of the Scattering of Light

PROF C G DARWIN, in his interesting account in NATURE of Oct 20, 1928 (p 630), makes a reference to recent work on the scattering of light It appears desirable in this connexion to point out that the existence in the light scattered by liquids and solids of radiations of modified wave length was established so early as 1923 by investigations made at Calcutta Dr K R Ramanathan showed (*Proc Ind Assn Sc*, vol 8, p 190, 1923) that when violet rays pass through carefully purified water or alcohol there is an appreciable quantity of radiations in the green region of the spectrum present in the scattered light Further studies of the effect in other substances are described by Mr K S Krishnan in the *Phil Mag* for October 1925 and by me in *Jour Opt Soc Am* for October 1927 These investigations were of course well known to workers in this field

In a lecture delivered at Bangalore on Mar 16, 1928, and published and distributed on Mar 31, investigations were described showing *first*, the universality of tho effect, namely, that it is observed in the widest variety of physical conditions (gas, vapour, liquid, crystal, or amorphous solid) and in the largest possible variety of chemical individuals (more than eighty different substances), *secondly*, that the modified radiation is strongly polarised and is thus a true scattering effect, *thirdly*, that each incident radiation produces a different set of modified scattered radiations, *fourthly*, that the scattered radiations consist in many cases of fairly sharp lines in displaced positions, and *fifthly*, that the frequency differences between the incident and scattered radiations represent the absorption frequencies of the medium These observations established and emphasised the fundamental character of the phenomenon in a manner which any isolated observation with a single substance would have quite failed to achieve

The Russian physicists, to whose observation on the effect in quartz Prof Darwin refers, made their first communication on the subject after the publication of the notes in NATURE of Mar 31 and April 21 Their paper appeared in print after *sixteen* other printed papers on the effect, by various authors, had appeared in recognised scientific periodicals

C V RAMAN

210 Bowbazar Street,
Calcutta, Nov 13

A Fresh-water Medusa in England

THE first record of a fresh water jelly fish in England was made by Sir Ray Lankester in a letter to NATURE, June 17, 1880 This little jelly fish was found in the *Victoria regia* tank of the Botanical Society in Regent's Park, and is most widely known as *Limnocodium Sowerbyi* By a deplorable decision of the Commission on Zoological Nomenclature, however, some modern writers have changed the generic name to *Craspedacusta*

I have now to record the occurrence of another fresh water medusa in a private aquarium in England The discovery was made by Mr Vernon Poulton, of Boscombe With great skill and patience he succeeded in finding not only the free swimming medusæ but also the very minute fixed hydrosome stage, and he has allowed me to see his preparations of both

The medusæ undoubtedly belong to the genus *Microhydra*, which has hitherto been recorded only from North American waters, and I see no reason for suggesting that they differ from the type species *M Ryderi*

Among the water weeds in the aquarium in which the medusæ were found were some plants of the American genus *Salvinia*, and it is possible that the *Microhydra* was imported into England attached to this weed, but according to Mr Poulton's observations, the hydrosome stage was always attached to grains of sand and not to the *Salvinia*

I wish to appeal to persons who cultivate *Salvinia* or other American water weeds in England to examine the water in their aquaria from time to time to see if these medusæ make an appearance They are colourless and almost transparent, and the diameter of the bell is about 1 mm, or $\frac{1}{25}$ inch The number of tentacles varies according to the age of the specimen, but there may be as many as twelve

The medusæ of *Microhydra* may appear in large numbers and then disappear for a long period, just like the medusæ of *Limnocodium*, so that several observations should be made at different times of the year before abandoning the search

In conclusion, I may say that, notwithstanding the opinion expressed by Mr F Payne in a recent paper, I am convinced that *Microhydra* is generically quite distinct from *Limnocodium*

SYDNEY J HICKSON

Cambridge,
Dec 10

The Instability of a Single Vortex-Row

SIR CHARLES SHERRINGTON, in NATURE of Sept 1 last, directs attention to the eddy effect which in a heart valve "prevents extreme eversion of the valve, and facilitates closure of the valve without delay or hindrance so soon as the diastolic check of the stream current ensues"

It may interest readers of NATURE to know that this effect was described very clearly by Prof George Britton Halford, the founder of the Medical School in Melbourne, the first in Australia His views were published in the *Lancet* and in a local medical journal, but perhaps most fully in a book, "The Action and Sounds of the Heart" (Churchill, 1860), from which I quote the following "A bullock's heart was obtained, and the auricles cut away nearly as low down as the auriculo ventricular openings, the cavities of the ventricles were well washed out, and the coagula carefully removed A vulcanised india rubber tube of like diameter with the pulmonary artery was then attached by one extremity to the vessel, and by the other to a common forcing pump, water was then thrown into the pulmonary artery, and the semilunar valves tightly shut down, gentle pressure being maintained, in imitation of what takes place in life The right ventricle, being empty, was in the same state as when the auricle is about to inject it On pouring water into the ventricle the flaps of the auriculo ventricular valve rose upon the surface of the fluid, until (the ventricle becoming fully distended) the valve formed a perfect septum between it and the auricle The left side of the heart was tested in the same manner, and with results perfectly the same, notwithstanding the greater thickness of the valve, the larger size of the musculi papillares, and the stronger chordæ tendineæ"

I find that it is not absolutely necessary to have the emergent artery closed under pressure The experiment in this simple form is made by my students individually—we call it Halford's Experiment—and always excites interest

W A. OSBORNE

The University of Melbourne

Nitrogen Fixation: the Growth of a New British Industry.[1]

HAVING now in general terms surveyed the *raison d'être* and the state of development of this modern industry, we will consider the circumstances of its establishment in Great Britain and the remarkable vigour of its growth under the direction of the Imperial Chemical Industries, Ltd.

The War had been in progress for some time before the importance of the catalytic process for the production of ammonia as a preliminary to its catalytic oxidation to nitric acid was sufficiently realised outside scientific circles. In due course, however, the Nitrogen Products Committee was established, and whilst recommending the cyanamide process as being the only possible process concerning which sufficient information was then available, organised research in other appropriate directions. Much careful investigation was carried out and valuable results were accumulated, although at that time naturally not published. As a result of the work of Greenwood, Rideal, Partington, and others at University College, London, the Department of Explosives Supply decided in 1917 to erect a plant at Billingham, near Stockton-on-Tees, for the purpose of producing ammonium nitrate by Haber's process, a grant of five million pounds being made to finance the project. However, when about a quarter of this sum had been spent, it was found that the dimensions of the task were so great as to prevent its completion in time to be of military value. The whole scheme was re-examined in 1919 and considered to bear promise of fruition as a peace-time industry. Negotiations led finally to Messrs. Brunner, Mond and Co., Ltd., agreeing to take over the assets and liabilities of the concern early in 1920, the technical staff, which had meanwhile been kept actively in being, moving to Billingham in June of that year; at the same time the subsidiary company, Synthetic Ammonia and Nitrates, Ltd., commenced its official existence. Now, of course, both of these companies form part of Imperial Chemical Industries, Ltd.

The whole problem had to be studied afresh from the beginning, and the first move was the establishment of a research laboratory, which incidentally cost some £80,000 (see Fig. 1). Simultaneously a small plant was erected at the works of the Castner Kellner Co., Ltd., at Runcorn, where pure ammonia has been made continuously since June 1921 in increasing quantities. The hydrogen employed was a waste product in the electrolysis of brine for the manufacture of caustic soda and chlorine. The experience so gained was found to justify the erection of a complete plant at Billingham, using as much as possible of the old material, and designed for the production of 30 tons of ammonia per day. So rapidly and enormously has the factory grown (see Figs. 2 and 3) that the present capacity of 70,000 tons of fixed nitrogen per annum will in 1929 or 1930 have been increased to 170,000 tons annually of fixed nitrogen, all of which, except for a comparatively small quantity employed in refrigeration, is used for the production of compounds of importance in agriculture, the dye industry, artificial silk industry, etc. In the meantime the village has become a small town, where 6000 employees will in a couple of years have been joined by a further 9000, where plans for 500

Fig. 1.—The laboratories of Synthetic Ammonia and Nitrates, Ltd., Billingham.

[1] Continued from p. 20.

houses, an entertainment hall, and a pavilion have been approved, and 500 more houses are in contemplation, where new playing fields and tennis courts are being provided, where, in short, a new industrial community is being established

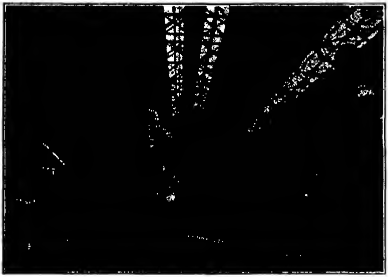

FIG 2 —New hydrogen plant

The technique of the production of ammonia by the Haber-Bosch process is essentially the technique of high pressure reactions It was immediately found that the ordinary types of plant, such as were then obtainable, were entirely inadequate for the needs of the new processes, so that the company was compelled to pioneer in this direction also, carving out its own path and learning during its progress That the task of design and manufacture of such high pressure apparatus is being satisfactorily accomplished is evident from Lieut.-Col Pollitt's statement that the plant is in many respects simpler to operate and easier to maintain than low pressure plant (see Fig 4) The process, in outline, is as follows Air and steam are together passed through incandescent coke in gas generators which provide for the efficient conservation of heat and full automatic control From the product, which consists of hydrogen, nitrogen, carbon monoxide, and carbon dioxide, the carbon monoxide is removed by catalytic interaction with steam, and the carbon dioxide by treatment with water under pressure, the hydrogen and nitrogen in the proportion by volume of 3 1 are then highly compressed and subjected to the action of the catalyst in converters the working temperature of which is 500° C The ammonia is dissolved in water and combined with some of the carbon dioxide previously removed In order to avoid the use of sulphuric acid in converting this ammonia into sulphate, the more economical process of causing the ammonium carbonate to react, in aqueous solution, with anhydrite (calcium sulphate) is employed Not only is the material ready at hand—there is a large deposit of anhydrite some 700 ft below the site of the works—but also the calcium carbonate which is precipitated in the reaction is of industrial value, being produced in a form suitable for the manufacture of Portland cement, or for combination with ammonium nitrate to produce a new fertiliser known as 'nitro chalk,' or for direct application to the land Other products are ammonium bicarbonate, anhydrous ammonia, and nitric acid (see Fig 5), the last named substance being, of course, produced by catalytic oxidation of the ammonia

Naturally, the experience gained in high pressure technique is being simultaneously applied to reactions other than that from which it originated, such, for example, as the production of methyl alcohol from water gas by a catalytic process It may eventually be possible to manufacture higher alcohols by means of this type of procedure, and the possibility of the conversion of methane, obtained by the distillation of coal, into acetylene and hence into numerous organic substances, is not to be ignored These developments have necessitated laboratory and research staff extensions in

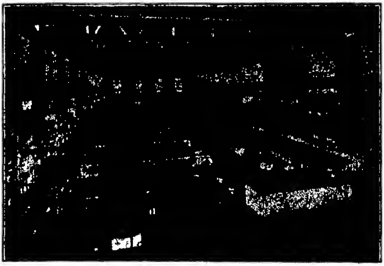

FIG 3 —Ammonia plant

rapid succession, for although the routine work has naturally increased, it remains a comparatively small fraction of the whole. The growth of an efficient instrument service, whereby so many different kinds of operation can be recorded and often controlled, whilst bringing in its train an important group of physical problems, simplifies in no small measure the task of accurate and knowledgeable control, and frequently indicates directions in which improvements are desirable

It will be seen that the trend of industrial chemistry evidenced by the work at Billingham under the direction of Imperial Chemical Industries, Ltd, is no less than the replacement of products obtained from agricultural operations by products obtained from coal Such a policy is in consonance with an era of mechanical transport, and it is peculiarly applicable to the British Empire Although, as has been indicated, in any future war the fixed nitrogen industry might well find itself the base on which successful military action rested, and Billingham, Newcastle, and Birmingham might typify the pivot around which policy might revolve, it must emphatically be realised that the existence and development of this industry is a requirement, and an urgent one, of times of peace It tends to bring comforts of modern civilisation within the reach of greater numbers, and its aim is to make two blades of grass grow where one grew before

FIG 4 —Buildings for new high pressure plant

FIG 5 —Nitric acid plant.

How far it succeeds in this latter aim can be judged, for example, from statistics supplied by Dr H J Page, head of the Nitram Experiment Station, which is operated by Nitram, Ltd, an associated company dealing with the application of the products manufactured by Synthetic Ammonia and Nitrates, Ltd Dr Page shows that by giving grassland at eighty centres in the British Isles a basal dressing of phosphate and potash, and then successive dressings of ammonium sulphate at short intervals the productivity is so increased that instead of two acres, only 0 72 of an acre is necessary to feed one cow As Sir Daniel Hall has pointed out, British farmers can now modify the traditional practice of understocking The British farmer, however, being somewhat conservative, and preferring usually to see before he believes, a 'Nitram' demonstration van tours the country in order to explain the new uses of sulphate of ammonia and nitro chalk, the van carries instructional leaflets, specimens of the products of Synthetic Ammonia and Nitrates, Ltd, specimen turves, etc A statement made at the second International Nitrogen Conference in the spring of last year by Sir Frederick Keeble is also worth recording, indicating as it does the margin between practice and possibility which is available for exploration and exploitation He remarked that at a recent potato growing competition organised by Nitram, Ltd, in Northern Ireland, the winner raised a crop of 28 tons to the acre, and no competitor raised less than 15 tons to the acre, whilst the average in England is less than seven tons per

acre Parenthetically, it must be noted that although fixed nitrogen is of such great importance in fertiliser practice, soil requirements of other elements have also to be provided Examples of the influence on crop yield of systematic fertilisation might be multiplied So also might examples of neglect to profit thereby For example, a correspondent to the *Times* (British West Africa Supplement, October 1928), describing farming conditions in Sierra Leone, writes " The second problem is that of maintaining the fertility of permanently cleared land by suitable manuring There are practically no horses and very few cattle In consequence there is no form of farmyard manure available, and the average native farmer sets more store on putting up some sort of 'ju ju to protect and encourage his crops than on considering the purchase of artificial manures ' Ju jus, let it be observed, are of divers kinds

The growth of the fixed nitrogen industry has lowered the prices, in terms of goods, of all nitrogenous fertilisers, and of phosphates and potash also, but we still lack sufficient accurate and co ordinated scientific knowledge of the extent of the benefits which may be ours of the factors determining soil fertility and climate , of the state of combination, interactions, proportions, and variations in the elements concerned At Rothamsted it has been realised that although an enormous mass of data was being accumulated, it was not being employed to the best advantage by older methods of examination, and in consequence modern statistical methods have been applied These methods have opened up a new line of study —the study of the influence of nutrients on the reaction of the plant to environmental conditions, that is, the influence of soil and climatic conditions on the effectiveness of fertilisers Those in the best position to judge have declared that, if the general character of a season could be predicted, appropriate manurial schemes could be recommended, or tables of expectancy of crop yield could be constructed for the guidance of insurance companies willing to insure farmers using recognised fertiliser mixtures against getting less than an agreed yield per acre

Finally, we must not, in contemplation of a rosy future, lose sight of the realities of the present Unless new knowledge is acquired, unless education in the modern use of nitrogenous fertilisers is advanced, the danger of overproduction may be great Mr F C O Speyer, the general manager and a director of Nitram, Ltd , estimated that if announced programmes in various countries are carried out, there should be an extra production of about 2½ million tons of nitrogen between June 1928 and June 1931 He calculates that, although 92 per cent of this could be absorbed by Europe alone if applied to main crops at the rate of 0 8 cwt per acre, the additional world population in this period would not consume more than half of the extra food which would thus be available On the other hand, Dr Bueb, managing director of the Stickstoff Syndikat, has pointed out that the monetary return on the use of nitrogen has steadily risen, and the prices of foodstuffs have been kept down The problem of production is subject to the economic laws, but co operation between the forces concerned—those directed by the chemist, the engineer, the agriculturalist, and the plant breeder, is so full of economic possibilities that it would indeed be unwise to base our estimate of to morrow's need solely on to day s demand

A A E

Biology and Education[1]

By Prof F A E Crew

THE method of education is the stimulation of the cells of the brain by impressions from without impressions provided by the casual and haphazard incidents of experience and by the deliberate and systematic agencies concerned with the imparting of facts and opinions The aim of education is so to guide the development of the individual that he can hope to discover his powers to recognise his limitations, and to determine the ways in which he may achieve the fullest degree of expression of his inherited mental and physical endowment in the circumstances, physical and social, in which he will find himself Education, therefore, is concerned with the living individual and with the habitat in which this individual is to live and, living, achieve his destiny So also is biology, the science which deals with the nature of living things and with the relation of these to their environment It seeks to find answers to the questions as to whence came man, what is man, and whither goeth he These are the very questions that occupy the popular mind to day Surely the tasks of the educationist must be those of equipping his experimental material with the ability to formulate these questions properly and of showing how and where their answers may be found

The most conspicuous factor in the history of civilisation during the last two hundred years has been the exploitation of physical Nature by means of scientific knowledge Science has provoked and made possible a complete metamorphosis of the western world since the middle of the eighteenth century, and during this time science has been nurtured by industry The Europeanisation of the world had its origins in the developments of commerce, and the broadening of the mental outlook which distinguished the Renaissance was made possible by the increased wealth and the increased leisure this commercial prosperity gave to western peoples The industrial revolution in England was but the inevitable sequel of the developments of trade during the period 1600–1750, and the present-

[1] From an address delivered before the Incorporated Association of Assistant Masters in Secondary Schools at Brighton on Jan 1

day appreciation of scientific knowledge in relation to the practical affairs of life is again the inevitable outcome of this industrial revolution

It is because man has gained so spectacular a control over his physical environment that science exercises such a dominant influence in Western culture to day, and it is because commerce has encouraged the development of the physical sciences for its own ends that physics and chemistry and allied sciences have grown so amazingly But it is not because these sciences are so much more complete than are the biological that they find a place in the school curriculum It has yet to be shown that physics and chemistry are keener tools wherewith to fashion mind than is biology I submit that they are now taught simply because they have been taught, and because they are not only useful educational instruments but also profitable when the pupil is translated to secondary school, technical college, and university Industry is demanding men trained in the physical sciences, and a knowledge of these subjects, while it may be helpful in a cultivation of the art of living, is most certainly useful in the business of earning a living If men were bought and sold to day, as they used to be, doubtless human biology would possess an equal importance

No part of one's general education should be coloured, however, by any consideration of what one will do in order to live general education is concerned solely with the development of an art of living, of teaching the developing individual how to think and how to feel and how to seek and gain opportunities for exercising these faculties Manifestly, during this period the individual must receive an introduction to science, since it is of the utmost importance that youth should acquire the scientific point of view Science has done more than merely give to man a marvellous power over material things it has revolutionised human thought It is this spiritual aspect of modern science that is its most significant virtue The revolution is still spreading, and it is in a world dominated more and more by this scientific habit of mind that our pupils are to live

Science has completely changed the concept of authority Credulity is no longer accepted as a virtue and doubt as a sin The final authority in spiritual as well as in temporal matters is no longer Scriptural phraseology and the traditional teachings of the sages of antiquity The Old Testament is no longer accepted as a trustworthy text book of human biology Belief must now rest upon evidence that is open to examination, and critical judgment has usurped the place of authoritative statement To day, mankind demands the right to seek the truth and to extend it without restriction facts, verifiable facts, are the only justification for authoritative statement This concept has to be presented to and accepted by the youth of to day

It was this revolution in human thought that led to the replacement in education of the asceticism and scholasticism of the Middle Ages by the humanism of the Renaissance and later to the replacement of this in turn by science To escape from the scholasticism that was becoming obnoxious it was necessary to turn to the literature of Rome and Greece Latin, the language of the learned, became the vehicle of the new humanistic philosophy, and, because the new ideal found its counterpart in the thought of ancient Greece, Greek became the pathway to this older source of European culture For these reasons, Latin and Greek assumed positions of great importance in education Times have changed, yet even now the position of these classical languages in educational schemes is robustly defended, though the original need for their teaching has disappeared The authority of tradition, enunciated in the pronouncements of classical scholars, no longer convinces The average man can, and should be encouraged to, capture the spirit of this humanism in adequate translations and interpretations, if these do not exist, then the classical scholar is blameworthy no one can afford to disregard the attitude of mind which requires that there shall be a spiritual joy in living and a confidence in the future, but the languages themselves are now the delicate hobbies of such as find more joy in the contemplation of the affairs of yesterday than in the adventures of living to morrow Every man does not require a knowledge of Greek, but he will require each day and every day a knowledge of the physico chemical mechanism that is himself

The acid test of scientific method is now applied in education, and the classics have been eroded The day of passive acceptance of that which is, because it has been, is passed It will be agreed that we are incredibly ignorant of what constitutes scientific procedure in education It will be agreed, further, that because certain time honoured standards have been overthrown the new ones are not necessarily final The value of science in the school curriculum is that it can replace adequately the humanistic philosophy of life in combating and vanquishing fear of the unknown This it is that physics and chemistry do, and that biology could do even better The time has already arrived when physics and chemistry, sciences that deal with the phenomena of man's environment, should make room for biology, for it is biology more than any thing else that is modifying human thought To day, the philosopher recognises the biological foundations of philosophy, the theologian the biological development of theology, the historian the biological framework of historical events But more important than all this is the fact that the average citizen is intensely interested in the biological nature of his own existence Biology occupies a pivotal position in human understanding, for mankind, having conquered its environment, is now seeking the control of itself and its destiny The life of every man is affected in all its aspects by the two great generalisations of biological science — the theory of the cell and the theory of organic evolution An introduction to these theories should therefore be given to all as part of their general education

In the specialised scientific education that follows

upon the general, biology is a necessity, it is as indispensable for the embryonic chemist and physicist as are physics and chemistry for the biologist Biology is no longer fragmented into the watertight compartments of zoology, botany, and physiology Comparative morphology is no longer over-emphasised, and through the develop ments in genetics, ecology, and experimental morphology the barriers between zoologist, botanist, and physiologist have been broken down The necessity for studying the physico chemical pro cesses of living organisms requires that the biologist shall be physicist and chemist as well, and the physicist and chemist with a knowledge of biology can find ideal material for the exercise of their techniques—the day of the biochemist and bio physicist has already dawned

Biology in its origin was closely associated with medicine and with agriculture The more scientific medicine and agriculture become the greater will be their demands upon biological science As biology becomes more exact in its conclusions it will claim an even greater value in the social sciences, in which fields its main contribution as yet is the point of view which it imparts But the significance of zoological and particularly of medical knowledge is becoming evident to the social worker, whose eagerness for the facts of heredity and hygiene is remarkable and will persist When once there has developed a biology of the group, a scientific interpretation of human behaviour, then biology will indeed exert a most profound effect upon the social activities of humanity The problems of evolution are no longer solved through the exercise of pure dialectic, biology has pro gressed towards the method of experimental analysis, and because its conclusions rest in creasingly upon experimentation they are held in higher esteem The voice of the biologist is now eagerly heard, because he speaks of facts that cannot be denied, of facts that concern the welfare of mankind

Biology is not commonly included in a school curriculum, for the reason that the headmasters of yesterday had no knowledge of the biology of to day It cannot be expected that most teachers of physics and chemistry should themselves agitate for the appointment of a biological colleague, for the reason that it is quite obvious that the total amount of time allotted to science in the school curriculum cannot be advantageously increased, so that if biology enters the school it must necessarily reduce the time now given to physics and to chemistry It is but to be expected, however, that I, a professional biologist in spite of my school education, should seek to advance the interests of my own subject Science advances through the general acceptance of its teachings as much as by additions to knowledge The teacher who pursues the implications of science and induces others to follow his example is no less important to scientific progress than he who contributes to the establishment of some technical generalisation

In a university curriculum there is no time to present biological facts in a romantic fashion, and in any case the student's capacity for recognising the wonders of the living organism that is himself is spoiled somewhat by the economic necessity of equipping himself vocationally in the shortest possible time He may become a biologist in later years, but at the university he is far too much occupied in his painful metamorphosis into a doctor, an agriculturalist, a veterinarian, an entomologist, or what not Only those matters that seem to possess an importance to him in his professional capacity are of any real interest to him during this phase Seldom does he capture the spirit of science, scarcely ever does he exhibit the scientific attitude of mind Soon we shall see biology alongside chemistry and physics as a pre registration subject it would be that even now if the mechanism for teaching it existed in the schools I, for one, look forward to the time when biology will be taught in the schools by carefully trained men, for school is the place where one should receive one's introduction to biology That is the time and the place to give to the temperamentally suitable the spirit of the naturalist This should be the endowment the school should give to youth

At the present time the schools are providing the universities with a more than adequate supply of botanically attracted maidens, whereas what we need is an increased supply of young men who know that they are destined to be biologists It is not because chemistry and physics are ultimately more profitable than biology that so many university students attend these courses, it is because so few have had biology at school, and because the majority of youths are urban-bred At the present time there is a demand for men with a biological equipment that cannot be supplied Imperial schemes for the advancement of agriculture are even now being embarrassed in their development because there are no young biologists to accept the posts that have been created In the Dominions and Colonies, agriculture is the all-important industry, and in agriculture a knowledge of biology is of greater usefulness than is a knowledge of physics Commonly, I am asked for advice concerning the prospects for a trained biologist I answer that a well trained man of suitable personality can readily start on a career which offers him a salary advancing from about £300 to £1000 To those who argue that this is not so good as a career in medicine, law, or commerce, I reply that I, for one, get from life rewards that cannot be found outside biology

What is more important to humanity than the manufacture of helminthologists, entomologists, and the like is, however, the further extension and democratisation of the evolutionary concept It was this that overthrew the medieval theology and completed the enlarging of the mental horizon of humanity Man's notion of himself has changed from that of a being recently created and awaiting a day of reckoning in a not too distant future to that of a being originating as part of organic Nature and set in a universe without beginning and without end This intellectual revolution has emancipated countless men from the bondage of authority It

must free all The evolutionary concept has been applied to religion and to philosophy Its influence is seen in sociology in the incessant questioning of the necessity for existing conditions—it has shaken the whole edifice of social tradition Disease and crime are no longer regarded as inevitable con sequences of the organisation of society to be treated by curative measures They are being attacked with all the scientific knowledge that we now have, and it is intended that they shall be eliminated by the evolution of a type of man and a form of society in which they will not exist Man is no longer content to allow natural forces to work their will upon him, he has challenged Nature, bending it to his will, and hereafter will direct his own evolution

The biological discovery of man's place in Nature has created the need for a biological training for priests and law makers, for further developments of civilisation will be made possible only through the growth of biological knowledge The nine teenth century saw revolutionary advance in the physico chemical field, the twentieth will see equal advance in the domain of biology In the past, man's control has been over inanimate things now the conquest of living Nature has begun

Antarctic Discoveries

IN his nine hours' flight of 1200 miles over Graham Land on Dec 19, Sir Hubert Wilkins made dis coveries of great value This was the first flight ever made in Antarctic regions and shows the value of air transport for the explorer in a part of the world where pioneer work has yet to be done In a few hours, travelling at a speed of 120 miles an hour, Sir Hubert reached farther south than any ship has ever been able to penetrate on the eastern side of Graham Land, where Captain Larsen in 1893 had managed to reach lat 68° S Previous knowledge of the coasts of Graham Land ended, with any detail, on the eastern side in about lat 66° S, and on the western side in about lat 69° S Beyond these latitudes, and even to the north of them in many places, knowledge was very sketchy

The main features of Sir Hubert Wilkins' dis coveries can be gathered from his dispatches to the *Times* From Deception Island he and Lieut Eielson flew south over the high peaks of Trinity Peninsula and the King Oscar coast, and almost exactly on the Antarctic Circle found an ice filled twisting channel joining the Weddell and Bellings hausen Seas The eastern end seems to open between the Weather (Wetter) Island of Larsen and another large island lying about 50 miles farther south From the description, this island would appear to belong to the zone of basaltic rocks that lies to the east of the folded zone of Graham Land

The eastern end of this strait was missed by Larsen and Nordenskjöld Larsen was too far east owing to the wide ice shelf on that coast preventing his ship approaching, and Nordenskjöld's farthest south on his sledge journey in 1902 was about lat 66° S Yet at that point he had a vague suspicion of the existence of a very long inlet if not a strait At its western end the strait discovered by Sir Hubert Wilkins no doubt opens into the great Auvert Bay which Dr Charcot placed north of his Loubet Land Auvert Bay has not been explored and its eastern end is left blank on the charts The *Times* reports that this new strait has been named Crane Channel

Farther south Sir Hubert Wilkins reports that the rugged ranges of South Graham Land decrease in height but rise again towards lat 70° S In that latitude there exists a second strait, named Stefansson Strait, forty to fifty miles wide joining the Weddell and Bellingshausen Seas Beyond this the ice cliff which borders the Weddell Sea from Coats Land westward seems to continue Very possibly it continues through the strait, borders the Pacific Ocean, and reaches King Edward Land About here Sir Hubert was forced by lack of fuel to turn, but he writes of the ice covered surface sloping upwards to the south, which suggests the high plateau of Antarctica This part of Antarc tica receives the name of Hearst Land The main land of the southern continent is probably entirely of the same plateau structure with conspicuous fault ranges in the Ross Sea area The theory that any part of the mainland is a region of Andean folding must now apparently be abandoned

These details will of course be amplified in the course of time and the photographic record of the flight will help to make the picture complete At present the news suggests that the folded ranges of Graham Land are lost by depression in about lat 70° S They probably skirt the ice covered plateau of Antarctica, appearing as emerged land in such areas as Alexander Island, Charcot Land, the volcanic Peter Island, and perhaps King Edward Land So little, however, is known of King Edward Land that its participation in the Andean folds cannot be stated with certainty The existence of many large tabular bergs off Alexander Island, which appears to lie near the western end of the large strait, suggested to Dr Charcot many years ago that shelf or barrier ice could not be far distant from that coast

Sir Hubert Wilkins' discoveries thus throw light on one of the chief problems of Antarctica, namely, the relation of the folded Andean structure of Graham Land and the plateau structure of Victoria and adjacent lands and probably of Coats Land The more striking discovery of the straits across Graham Land is actually of less importance It has been known since the days of the *Belgica* expedition towards the end of last century that Graham Land was a heavily submerged area Its continuity with the folds of South America has been lost by submergence Belgian and French expeditions on the west, and Swedish and other expeditions on the east, have shown the extent of submergence in outlying archipelagoes and deep inlets Channels crossing from coast to coast are not surprising in such a land In South America such channels occur in the far south These newly

discovered straits are probably seldom if ever clear of ice in fact, they are probably filled with shelf or barrier ice rather than sea ice

Unfortunately, Sir Hubert Wilkins could not land, as his machine had wheels and he saw only snow surfaces fit for ski But the discoveries show the way for future work, which it is to be hoped may be done at least in part by Sir Hubert himself during the present season A flight from Deception Island to Com Byrd s base at the Bay of Whales in the Ross Sea could not fail to have interesting results, but it would be a long flight and a far more hazardous than the one already accomplished R N R B

Obituary

DR C R YOUNG O B E

CHARLES ROBERT YOUNG was born at Nottingham on Mar 4 1880 and was the son of Robert Young a bank actuary of that city He received his early education at the Nottingham High School, and from there went to the Royal College of Science, where he remained from 1899 until 1901 He obtained the B Sc degree of the University of London and was then appointed lecture assistant to Prof Purdie of St Andrews a position which he held until 1903

In 1903, Young was appointed research assistant to Prof Purdie and lecturer in the University and until 1907, was engaged in carrying out some important researches with Prof Purdie Among these may be noted a paper on the alkylation of rhamnose and one on the optically active forms of alkyl oxysuccinic acid two important applications of the reaction for the alkylation of hydroxy compounds introduced by Purdie which has proved so fruitful in elucidating the constitution of the sugars He was awarded the D Sc degree of the University of St Andrews on the results of his research work From 1907 until 1915 he held the post of lecturer in chemistry at the University of Sheffield, and here although his duties prevented him from continuing his research work, he proved himself to be an able and effective teacher

When the late Dr A W Crossley, early in 1916 resigned the secretaryship of the Chemical Warfare Committee in order to take over the control of the then newly established experimental station at Porton, he was moved to recommend Young for the post for Crossley was a great judge of men and had recognised Young's special qualifications while acting as external examiner at St Andrews and Sheffield From this date until the end of the War Young fully justified Crossley s choice and carried out the duties of his difficult office with that tact discretion, and thoroughness which characterised all his work He endeared himself to all members of the Committee by his willingness to serve and by his innate modesty and unfailing courtesy When in 1919 there arose the question of the appointment of a technical officer for the Department of Scientific and Industrial Research, the three members of the Committee, who were also members of the Advisory Council of the Department, were unanimous in recommending Young for the new post

Young served the Department for nearly ten years, and was, at the time of his death, secretary of the Scientific Grants Committee All those who came in contact with him, both in his official and personal capacities, recognised his true worth He had a kindly rather shy, temperament and a very lovable disposition Self effacing and modest, he nevertheless held his views strongly and was quick to express them with force when occasion required He was created an Officer of the British Empire for his War services He died on Dec 26 last, after a brief illness, and leaves a widow and two daughters J F T

WE regret to record the death of Dr Dawson F D Turner at the age of seventy one years He was one of the few medical men who took up the study of X rays in medical work in the real pioneer days Unfortunately, he suffered from the rays when their dangerous character was scarcely known, but this did not prevent many years of excellent work on his part He was head of the X ray department in the Edinburgh Royal Infirmary for nearly twenty five years, and during this time contributed original papers on the subject of X rays and medical electricity His book on the therapeutics of radium was one of the first, if not the first, published in Great Britain He was a vice president of the Rontgen Society and at one time president of the Royal Scottish Society of Arts

WE regret to announce the following deaths

Prof John M Coulter, professor of botany in the University of Chicago from 1896 until 1925 and a foreign member of the Linnean Society of London, who has been editor of the *Botanical Gazette* since 1875, on Dec 23 aged seventy seven years

Mr J S Diller, who served with the U S Geological Survey for forty one years and was well known for his studies of the geology of the Pacific Coast, on Nov 13, aged seventy years

Dr Alois Kreidl, professor of physiology in the University of Vienna on Dec 6, aged sixty four years

Prof F P Leavenworth emeritus professor of astronomy in the University of Minnesota known for his work in astronomical photography, on Nov 12, aged seventy years

Sir Charles Macara, Bart, founder of the International Federation of Master Cotton Spinners' and Manufacturers Associations and widely known in industrial circles, on Jan 2, aged eighty three years

Prof E H L Schwarz, professor of geology in Rhodes University College, Grahamstown, South Africa, on Dec 19, aged forty five years

Sir Henry Trueman Wood, secretary from 1879 until 1917 of the Royal Society of Arts, on Jan 7, aged eighty three years

Prof Alexander Ziwet, professor of mathematics at the University of Michigan since 1888, and an associate editor of the *Bulletin of the Mathematical Society*, on Nov 18, aged seventy five years

News and Views

THE descriptive statements which have been published from time to time indicate both the nature of the King's illness and the treatment adopted more fully than is possible in the daily bulletins and enable a clear picture of the course of the malady to be formed The illness began as a streptococcal septicæmia, with later localisation of the infection between the base of the right lung and the diaphragm such a 'fixation abscess' is of favourable import, since its appearance is usually followed by a lessening of the general infection Apart from treatment directed towards the maintenance of the patient's strength, including the assimilation of appropriate nourishment, the aim has been to aid the development of the body's defences against the attack of the micro organisms and to maintain the blood and tissues generally in as nearly normal a condition as possible Thus the application of ultra violet rays to the skin in suitable dosage should result in an increase in the bactericidal power of the blood, whilst the organisms in the abscess cavity in the chest can be more directly attacked by the application of antiseptic solutions For this latter purpose a solution of hypochlorous acid containing active chlorine, which was developed during the War by Carrel and Dakin for the treatment of septic wounds, has been used its advantages are that it is almost non toxic to living tissues, including the white cells of the blood which enter the abscess cavity to ingest and destroy the organisms, although acting deleteriously upon the organisms themselves

IN the early days of the King's illness the presence of the organisms in the blood stream resulted in a definite anæmia, but with the lessening of the infection the number of red blood corpuscles has increased again and a transfusion of blood has not been considered either necessary or advisable On the other hand, chemical examination of the blood has of late shown a deficiency of calcium, which is being combated by the administration of a salt of this element with parathyroid extract The parathyroid glands are known to have some control over the calcium metabolism of the body, experimental removal is followed by a fall in the blood calcium, accompanied by the development of muscular spasms known as tetany administration of an extract of the glands raises the blood calcium and abolishes the symptoms The extract is effective also in other conditions not obviously connected with disturbance of the parathyroid glands, in which the blood calcium has fallen to a subnormal level In the present case it is probable that the presence of the abscess in the chest has effected a drain of this element from the blood Elevation of the blood calcium will also aid in raising the blood pressure, which has fallen below the normal level during the course of the illness Improvement appears to be taking place slowly, but surely enough to justify the hope that the King will be restored to his people

THE sixth annual meeting of British Zoologists was held in the rooms of the Zoological Society on Jan 5, ninety zoologists being present The meeting discussed the interim report of the Royal Commission on National Museums and Art Galleries, and after a long and interesting discussion passed, unanimously, a resolution "That the Trustees of the British Museum be approached in order to represent the urgency of putting upon an equal and independent basis the direction of the two branches of the British Museum at South Kensington and Bloomsbury" The important research work, not only in academic but also in economic zoology, which is carried out in the Natural History Museum is held by zoologists to justify an autonomy which does not at present exist The needs of the Museum and the nature of the work carried on in it differ so greatly from those of the library and archæological sections, that the necessity of conducting business through the accounting office at Bloomsbury necessarily involves a hindrance to its work

THE meeting of British Zoologists also discussed the present shortage of trained zoologists for technical posts Instances in which it had been impossible to find a suitable applicant for most attractive posts were reported Mr S G Tallents, the secretary of the Empire Marketing Board, showed that a considerably increased demand for biologists may be expected from the tropical dependencies The shortage seems to depend on the unwillingness of students, or of their parents, to face the risks of undertaking a career in which the total number of posts is very small in comparison with the openings in such a profession as medicine or even with those available to chemists The attractiveness of zoology as a career is further decreased by the fact that even the most highly paid zoologists receive a salary which would represent no more than a very modest success in medicine or other professions In addition, zoological appointments fall to be made at irregular intervals, and are unpredictable It is thus impossible to ensure a student whose interest is in fisheries research that there will be a post vacant four or five years hence when he finishes his university course Zoologists of the last generation pursued that science because they felt that it mattered, to them at any rate, more than other things, they trusted to their abilities to gain them a livelihood, even if a poor one The modern student wishes certainty, a permanent post with a pension The meeting passed a resolution in favour of the establishment of an association of professional zoologists and appointed a committee to consider the constitution of such a body

WE fear that the advocates of better and more extended biological teaching in schools will read the recent correspondence on this subject in the *Times* with mixed feelings The correspondence began with Sir Charles Robertson's comments on Mr Ormsby Gore's report of his visit to Malaya, Ceylon, and Java, which is the subject of the leading article in this week's issue Sir Charles indicates four main causes for the present unsatisfactory position our urbanised

and industrial outlook, the dominance of chemistry and physics in the school science course, the congested school curriculum, the newness of the subject He believes that until the situation in the secondary schools is altered, no amount of propaganda by government bodies and no changes in the attitude of the universities will avail in providing the greatly increased number of qualified biologists urgently needed in the Empire In this he will be fully supported by those who have studied the problem of introducing a proper biological course into the schools Nevertheless, it is only an incidental reason, great though its material importance undoubtedly is The real justification is set out, almost alone among those taking part in the correspondence, by the headmaster of Dauntsey School 'Biology has a spirit and soul as well as a money value' For the rest, the arguments cover familiar ground The universities are blamed by some for unwitting obstruction, and are praised by others for encouragement in excess of that warranted by present conditions Attention is directed to the disparity of income between leading biologists holding official positions, and moderately successful lawyers, doctors, and tradesmen—a contrast which loses much of its point because it applies to physicists and chemists as well, with the exception of a very few in the leading industrial organisations

WE can only hope that constant ventilation of the subject will help to direct attention to the analysis of the position and the definite recommendations made in two reports, dealing with animal biology in the school curriculum, and science in the school certificate examinations, respectively, which were presented at the Glasgow meeting of the British Association If any doubt existed as to the urgent need of fully trained biologists in the Empire, it would be removed by Mr Ormsby Gore's address on "Developments and Opportunities in the Colonial Empire," given at University College, London, under the auspices of the Association of Scientific Workers He pointed out that nearly all the non self governing colonies have now reached the stage of evolution necessitating the establishment of a whole series of technical services to assist their economic and cultural development The majority of the non self governing colonies lie in or near the tropics, and their resources are almost entirely agricultural Biologists, specialised in the numerous branches of this science, are urgently needed in the agricultural field and in all branches of medical work In addition to this perhaps self evident need, there is the highly significant fact that in the very difficult task of educating the native population the only contacts between the mind of the British teacher and that of the indigenous population are biological The natives cannot see any benefit in education unless it deals with their ever present preoccupations—their struggle for existence, the health of themselves, their animals, and crops

THE Council of the Physical Society has awarded the sixth (1928) Duddell Memorial Medal to Dr Charles Édouard Guillaume, the Director of the Bureau International des Poids et Mesures, Sèvres The medal is awarded annually to some one who has contributed to the advancement of knowledge by the invention or design of scientific instruments or by the discovery of material used in their construction Dr Guillaume is known to the world for the invention of three metallic alloys of great importance, invar, elinvar, and platinite Industrially, the last one of the three is much the most important It is a nickel-iron alloy having approximately the same temperature coefficient of expansion as glass, so that it can be fused into glass and used as the wire for introducing the current into electric incandescent lamps The wire is frequently covered with a thin coating of copper to which the glass adheres, and in this form the wire is known as 'red platinum' As about one thousand million lamps are made annually, the saving between the cost of platinum wire, which was the only suitable material formerly available, and the alloy, approximates to £1 000,000 per annum

THE other two alloys associated with Dr Guillaume's name are of great scientific importance Invar, a nickel steel, discovered in 1896, has practically no temperature coefficient of expansion so that the length of a surveying tape made of it is almost unaffected by temperature Its use in accurate surveying work has reduced the time taken to one fiftieth of that required a few years ago The pendulum rods of all modern first class clocks are also made of the same material The third material, elinvar, was invented by Dr Guillaume for the manufacture of the balance springs of watches The coefficient of elasticity of elinvar does not change with temperature, so that the control exerted by the spring does not vary with temperature It is estimated that about five million watches are made annually in which the balance springs are of this material In his earlier scientific career, Dr Guillaume did a great deal to develop the accuracy of measurement obtainable with the mercury in glass thermometer His book "Traité pratique de thermométrie de précision," published in 1889, has remained the classic on the subject Dr Guillaume has published many papers connected with the standards of metrology, and his name is synonymous with accuracy of measurement He was appointed Director of the Bureau des Poids et Mesures in 1915, and received the Nobel Prize for physics in 1920

THERE was an international celebration of Sir J C Bose's seventieth birthday on Dec 1 In India the Maharaja of Nepal, the governors and chancellors of different universities, sent their delegates, and Rabindra Nath Tagore composed a special poem for the occasion Congratulatory messages were received from many leading representatives of progressive knowledge in Europe, and Romain Rolland, the distinguished man of letters of the Sorbonne, Paris, wrote "You have incorporated into the Empire of Spirit the new Universe of Life which only yesterday was taken as unconscious, dead and buried in the night" The National Research Institute, Nanking, sent the message that "the world looks to you to lift science into the realm of Spiritual Reality All Asia

shares in your glory" Sir J C Bose in course of his reply, said that he had "for the last forty years worked towards winning for India a recognised place among federation of nations by her contributions for extending boundaries of knowledge The world is to day divided into warring hosts threatening the very existence of civilisation There is only one way to save world wide ruin, and that is by intellectual co operation for the common benefit of mankind" At a meeting of the Senate of the University of Calcutta on Dec 8, a resolution was passed congratulating Sir J C Bose on the work he has done for the advancement of science

In a paper entitled "Economic Application of Electricity to Low Temperature and Heating Purposes," read before the Institution of Heating and Ventilating Engineers on Jan 2, Mr G Wilkinson described an economic application of electricity for heating purposes by means of a 'change circuit' By this means the load factor of supply stations can be increased and domestic electric heating becomes a possibility on cost alone Mr Wilkinson said that, assuming an increase in load factor from 25 per cent to 75 per cent, there were available during the year 1927–28 for heating purposes the enormous total of 19,855,701,260 kilowatt hours at $\frac{1}{2}$ penny This amount is being increased every day with the growth of the constant voltage supplies Energy in the form of electricity has the advantage that it can be readily delivered at any point where heat is required, and the expense of pipe transmission and heavy heat losses of transmission are saved Each floor of a building, and if necessary each radiator or panel, may have its separate storage cylinder which will absorb the constantly varying amount of energy received from the 'change circuits,' thus forming a heat reserve to be drawn upon at such times and rates as required to maintain uniform temperature under all weather variations The absence of combustion and the products of combustion enables these cylinders to be placed in positions where any radiation loss is usefully employed, and the whole system lends itself readily to convenient applications not obtainable with any other form of heating

Noise, it is becoming realised, is an important and to some extent preventible affliction which civilised and gregarious human beings are called upon to suffer Although, in a strictly scientific sense, all noise is not harmful, or even unwelcome, the pleasant noises are generally called by some other name Among the definitely deleterious varieties is undoubtedly that of modern road traffic, and any means of dealing with that part of the nuisance amenable to treatment—provided such means are reasonably economical, fairly efficient, and not unduly inconvenient—are bound to attract the serious consideration of highway engineers, of medical men, and of dwellers in noisy cities In a paper read by Lieut Col T H Chapman at the conference on rubber roadways and floor coverings, held under the auspices of the Institution of the Rubber Industry and the Rubber Growers' Association on Jan 3, a useful survey of progress in the employment of rubber for this purpose was presented It is not claimed that rubber is, in every sense, an ideal material, for such would exhibit absolutely no deterioration or wear under usage and weather Rubber is, however, smooth without being slippery, hard yet resilient, impervious to moisture, dustless, and easily cleaned, it absorbs vibration, diminishes noise, and requires no maintenance, hence rubber goes a long way towards meeting the requirements of the ideal Whilst granite setts, asphalt, and wood blocks all have their distinctive advantages, there are special areas where the cost of rubber should not be allowed to obscure its obvious merits The latest examples of rubber paving laid in London are on the approach to Fresh Wharf (London Bridge), in New Bridge Street (Blackfriars), Thurloe Place (South Kensington), and Croydon Road (Anerley), at Edinburgh in Shandwick Place, and at Glasgow in Buchanan Street Lieut Col Chapman indicated directions in which technical difficulties are still obstructive, at present, for example, rubber cannot be laid and then vulcanised *in situ*, although an advance in the direction of 'carpeting' with vulcanised rubber appears practicable So far as reduction of noise is concerned, tests in Whitehall showed that, compared with wood paving, the reduction was 30 per cent, that the residual noise was less objectionable, and that vibration was diminished

Rubber flooring was discussed at the same conference by Dr S S Pickles Here the problem is less of a technical than of an educational nature The reputation of rubber as a floor covering is well established, and despite the somewhat high initial cost, the low price of rubber now affords wider opportunities for its employment Its shock absorbing properties and comparative noiselessness are self evident advantages It is, moreover, interesting to note that its use in a London church was attended by an improvement in the acoustic properties, rubber flooring thus absorbs sounds already produced Further, the poor conductivity for heat and electricity, the resistance to abrasion, and the fact that it is waterproof and non absorbent, all contribute significantly to its claims for a more widespread public and domestic use Dr Pickles gave much information concerning the types and properties of rubber floor coverings which should prove of service to an architect desiring to develop flooring schemes in keeping with the character of his structure Incidentally, he mentioned that he had had under personal observation for nearly twenty years rubber floors in a chemical laboratory and in a power house, both were still in excellent condition as regards wear When referring to the types of apparatus employed in estimating the suitability of rubber and rubber compositions, and to the need for constant examination and control of products on the part of manufacturers, he said that if a composite plate of rubber and steel is subjected to a sand blast, the steel portion may be worn completely through, leaving the rubber almost unaffected

The Institution of Chemical Engineers has decided to institute, in commemoration of the late Lord

Moulton, two awards for papers on chemical engineering subjects The senior award will consist of a medal in gold, bearing a likeness of Lord Moulton on the obverse, and be awarded for the best paper of the year of a mature character, read before the Institution and published in the *Transactions* The award will not be confined to members of the Institution The junior award will consist of a similar medal in silver, with a prize of books to the value of £3, for which graduates and students of the Institution only will be eligible The award will be made for the best paper of the year communicated to the Institution, and deemed of sufficient merit to be published in the *Transactions*

IN connexion the World Engineering Congress which will be held at Tokyo on Oct 29–Nov 22 by the Kogakkai, or Engineering Society of Japan, and supported by the Japanese Government, a conference of representatives of twenty three institutions and societies met recently at the Institution of Civil Engineers to consider the best means by which British representation at the congress could be organised As a result, "The British Committee on the World Engineering Congress in Japan" was formed, having its secretariat and place of meeting provided by the Institution of Civil Engineers The Committee has as its objects the organisation of a party of British engineers to attend the Congress, and the securing of papers for presentation, and a small executive committee under the chairmanship of Sir Brodie Henderson has been appointed The Congress will be the first of its kind held in Japan, and it is evident that the Japanese with their usual energy are making every effort to make it worthy of the progress achieved in that country It is therefore the earnest wish of the Committee to awaken the interest and enlist the support of engineers, so as to ensure adequate British representation at the Congress by the presence of a large party of delegates and by the presentation of a number of papers

RADIO advices from the non magnetic yacht *Carnegie*, which left Balboa, Canal Zone, on Oct 25 for the first passage in the Pacific of her Cruise VII, state she arrived at Easter Island on Dec 6, four days ahead of her schedule, with all well on board and after a fine trip with ideal weather conditions and no storms The observational work during the passage from Balboa to Easter Island included 58 magnetic stations, 10 ocean and tow net stations, 70 sonic depth determinations, 24 pilot balloon flights, 6 evaporation series, 23 biological stations, 25 days of photographic records of atmospheric electric potential gradient, and four 24 hour runs of other atmospheric electric elements Because of a slight leak which developed in the depth-finder oscillator (mounted on the keel of the vessel), echoes for soundings have been obtained through firing of a shotgun at the end of a pipe extending 20 feet below the surface, the results with this emergency arrangement have checked well with depths determined by wire and pressure

IN commemoration of the centenary of the birth of John Innes, the council of the John Innes Horticultural Institution, Merton, is holding a conference on polyploidy as a source of species and horticultural varieties, on Saturday, Jan 19, at 2 30 P M All who are interested are invited to attend, tea will be provided

ON Tuesday next, Jan 15, at 5 15, Dr F A Freeth will begin a course of two lectures at the Royal Institution on critical phenomena in saturated solutions, and on Thursday, Jan 17, Major Gordon Home delivers the first of two lectures on Roman London The Friday evening discourse on Jan 18, to be delivered by Sir William Bragg, will describe further progress in crystal analysis, and, on Jan 25, Prof A C Seward will speak on the vegetation of Greenland

IN connexion with our article entitled "A Neglected Aspect of Scientific Research" (NATURE, Dec 15, p 913), it is of interest to know that the British Society for International Bibliography has recently been formed to deal with questions of classification It is a daughter society of the Institut International de Bibliographie and has its headquarters at the Science Library, South Kensington, London S W 7, where the Brussels Decimal Classification is used The honorary secretary is Mrs S M Tritton

RECENT issues of the *Daily Science News Bulletin* (by Science Service, Washington D C) direct attention to the great epidemic of influenza which is spreading widely over the United States, and has also reached Canada Cases of ordinary so called influenza usually occur mostly in January and February, while 'epidemic influenza' occurs at any and all times of the year This suggests that the present outbreak is one of epidemic influenza, the last visitation of which was in 1918

MR J T CUNNINGHAM writes to point out a mistake in the use of terms which occurs in a review by Prof Karl Pearson in NATURE of Dec 22, 1928, p 955, column 2, line 7 Although the meaning of the passage was probably clear to most readers, Prof Pearson is glad to have an opportunity of correcting the slip What he intended to say was that "the lack of anterior pigment as judged by a lens is asserted to indicate that the individual has a truly blue eye, and will produce gametes carrying a recessive unit factor for blue Two such lens tested individuals will produce only true blue eyed children"

THE latest catalogue of Messrs Dulau and Co, Ltd, 32 Old Bond Street, W 1, is No 163 It gives the titles of upwards of 900 second hand books of botanical interest, classified under the following headings Herbals, early gardening, fruit culture, etc, prior to the year 1700, horticulture, gardening, fruit culture, etc, after the year 1700; botany, botanical travels, agriculture, etc, and cryptogams, plant pathology, etc

MESSRS OGILVY AND CO, 20 Mortimer Street, London, W 1, have sent us a catalogue of shop-soiled and second hand instruments and apparatus, mainly microscopical Messrs Ogilvy have decided

to discontinue their second hand department and in consequence are disposing of their second hand stock, which includes a large and varied selection of microscopes and accessories and microscope preparations

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —A technical assistant at a Naval Experimental Establishment—The Secretary of the Admiralty (C E Branch), Whitehall, S W 1 (Jan 12) A head of the Department of Pharmacy in the Bradford Technical College—The Principal, Technical College, Bradford (Jan 15) A lecturer in physics and electrical engineering at the Handsworth Technical College—The Chief Education Officer, Education Office, Council House, Birmingham (Jan 19) A science master at the Lawrence Royal Military School, Sanawar, India—The Secretary to the High Commissioner for India (General Department), 42 Grosvenor Gardens, London, S W 1 (Jan 19) A lecturer in civil engineering and building trades work in the Engineering Department of the Portsmouth Municipal College—The Secretary, Municipal College, Portsmouth (Jan 25) A junior scientific officer under the Directorate of Scientific Research, Air Ministry, for research in applied physics, chiefly in connexion with aeronautical instruments—The Chief Superintendent, R A E , South Farnborough, Hants (Jan 26) An investigator at the Mines Department Testing Station at Sheffield—The Under Secretary for Mines, Establishment Branch, Mines Department, Dean Stanley Street, S W 1 (Jan 28) A principal of the Government Technical School, Accra, Gold Coast—C A [T], The Secretary, Board of Education, Whitehall, S W 1 Scottish candidates —[T], The Secretary, Scottish Education Department, Whitehall, S W 1 (Jan 28) An engineering assistant in the County Surveyor's Department of the Wilts County Council—The Clerk of the County Council, County Offices, Trowbridge (Jan 28) A research assistant (botanical) and a research assistant (an entomologist) in the department of plant pathology of the Albert Agricultural College, University College, Dublin, for the investigation of virus diseases of plants—The Secretary, University College, Dublin (Jan 31) A lecturer in physics in the University of Western Australia—The Agent General for Western Australia, Savoy House, 115 Strand, W C 2 (Jan 31)

Our Astronomical Column

ELONGATION OF MERCURY —The easterly elongations of Mercury in spring are the most convenient and favourable of the year for observing this planet They occur in 1929 on Jan 22 and May 15, and the former will afford some excellent opportunities for viewing the planet from about Jan 14 until Jan 28 On Jan 16 Mercury will set about 1½ hr after the sun, on Jan 26 about 1¾ hr later It will be brighter before the date of elongation than afterwards, so that observations should be attempted during the third week of the month It will be moving in an easterly direction amongst the southern stars, but at the close of January will appear stationary in the western region of Aquarius

The times of setting and apparent brilliancy of the planet will be as follow

		Mercury Sets (G M T)	Apparent Stellar Lustre			Mercury Sets (G M T)	Apparent Stellar Lustre
Jan	14	17^h 38^m	- 0 74	Jan	22	18^h 12^m	- 0 34
,,	16	17 47	- 0 70	,,	24	12 16	- 0 18
,,	18	17 57	- 0 62	,,	26	18 18	- 0 02
,,	20	18 6	- 0 50				

The brightness of the planet will therefore exceed that of such stars as Vega and Arcturus, and with a clear sky there should be little difficulty in detecting it

REAL AND FICTITIOUS METEOR RADIANTS —V A Maltzev of Leningrad contributes a paper on this subject to *Astr Nachr* , 5604 He quotes Dr C P Olivier as saying that he was prepared to find that half the radiants in his catalogue did not correspond with real meteor streams The rule adopted was that a radiant needed at least four meteors on the same night passing through a circle 2° in diameter to establish it

Experiments were made at Leningrad by letting pins fall at random on a horizontal board graduated to correspond with a region of the sky extending over 90° in right ascension and 75° in declination The point of the pin denotes the direction of motion It would seem that very accurate horizontality of the board is necessary, otherwise the pins have a tendency to roll about their points The conclusions drawn from the experiments are that more than half the published radiants are fictitious, and that more than 4 meteors through a 2° circle are required to establish a radiant With a total of 100 meteors observed, it is considered that 11 meteors through a 2° circle are required As the total number of meteors observed becomes less, the number required for a radiant slowly diminishes, being 8 when the total is 50, and 5 when it is 10 But 4 meteors will still suffice when the same radiant is confirmed by observations in other years on the same calendar date

SAN LUIS CATALOGUE OF 15333 STARS —The Carnegie Institution of Washington has just published this very useful catalogue The late Prof Lewis Boss felt the need of modern observations for many of the stars south of the equator in his Preliminary General Catalogue, and arranged that the Albany transit circle should be set up at San Luis, Argentina, so that the northern and southern observations should be obtained under as nearly as possible the same conditions, the observers being also the same Prof Tucker was in charge of the expedition, which worked so energetically that 87,000 observations were secured between April 1909 and January 1911 A series of photometric observations then commenced, which terminated in February 1913

The reductions have been carried through with great care, the refractions being carefully studied Stars were not observed both by reflection and directly at the same transit , at Greenwich also it has been found advisable to abandon such double observations , the second one being made in a hurry, after swinging the telescope through a large angle, was found to be subject to systematic errors A comparison of both the Albany and San Luis catalogues with the P G C shows that the two former agree very well with each other, but the systematic difference from the P G C reaches 0 4″ in the neighbourhood of 20° N Decl There are many faint stars in the catalogue, some of mag 10 4 Their positions are given for 1910 0 , there is no discussion of proper motions

Research Items

PREFERENTIAL MARRIAGE IN SOUTH AFRICA —In *Africa*, vol 1, No 4, Werner Eiselen studies the conditions of marriage among the various races of South Africa in order to show that the property family marriage entails a number of obligations on the interested parties When marriage depends, as it does here, on a bride price, the desire of a young man for marriage, entailing payment of property which he has not yet had an opportunity to acquire, ceases to be a matter for the individual and brings in the family The bride price is provided by the family This among the Bantu is in the form of cattle, their only wealth The types of marriage are cross cousin marriage, when the children of brothers and sisters intermarry, but the marriage of the children of sisters is forbidden, the sororate, when a man marries his deceased wife's sister, but it is the third and not the second sister who may thus be acquired, and marriage by inheritance when a man's wives are appropriated by his heirs—the principal heir being the eldest son, his own mother going to a younger brother of the deceased These forms of marriage with their variations in detail are the natural result of a system of contract between two families based on the exchange of women for cattle or other property of equivalent value Among the Xosa, where the levirate does not exist, a widow may either marry a stranger who repays the cattle originally paid with a discount for each child already born, and retained by the husband's family, or she has to stay with her husband's people In the latter case children born as the result of intercourse with non related men are looked upon as the legitimate children of her deceased husband

THE IRON AGE IN ITALY —In *Man* for December, Dr Randall MacIver discusses recent theory on the absolute chronology of the Early Iron Age in Italy, basing his argument on views recently put forward by Prof Sundwall This author holds (1) that the Villanovans were driven from Central Europe by climate change in the ninth century B C, and (2) that no painted pottery of Greek origin could come into Italy except via Cumae, and therefore sites on which it occurs must be later than 750 B C Against this view Dr Randall MacIver argues that, whatever the date of the climatic crisis, it does not fix the date of the migration, which may have taken place long before the final phase of hardship was attained Further, other motives for migration may have been operative As regards the second point, it is entirely disproved by recent excavations The Greek pottery of Canale belongs to the eighth and ninth century, and is directly connected with the Dipylon schools The sites, then, on which the pottery are found are therefore earlier, not later, than 750 B C Dr Randall MacIver's own dating places the First Benacci period at 1000 B C or earlier, Ducati brings it down to the ninth or eighth century Dr Randall MacIver here makes two modifications He accepts the rejection of his dating of 850 B C for the Warrior's Tomb at Corneto, though he thinks it cannot be later than the first half of the eighth century, and he now puts some of the Vetulonian tombs so late as 650 B C

ORIGIN OF THE FAUNA OF LAKE BAIKAL —Lake Baikal in Siberia has always been considered to have a highly peculiar fauna, with a number of forms not occurring anywhere else Recent investigations of fresh water faunas of the northern hemisphere tend, however, to disprove that view, since many groups and species of animals which were regarded as endemic to Lake Baikal have been found elsewhere Thus the genus of sponges *Baikalospongia* was found in a lake near the river Yenisei, amongst the Oligochæta, 13 species of the genus *Lamprodrilus* are peculiar to Baikal, but four more are now known in Europe and Siberia, a representative of another Baikal genus, *Teleuscolex*, has been discovered recently in Lake Okhrida in Macedonia, the genus *Propappus* (fam Enchytræidæ) was known only from Baikal, but one species has been described from Elba and found afterwards in the Volga and other Russian rivers, as well as in Lake Baikal itself, amongst the Crustacea, the genus *Echinogammarus* is represented in Lake Baikal by 39 species, and there are four more species, namely, one in Lake Okhrida, one in the Faroë Islands, one in Tripolitania, and one in Spain, France, and Germany The Baikal molluscan genus *Choanomphalus* is also represented in Lake Okhrida An endemic Baikal diatom, *Gomphonema quadripunctata*, has been recently found in the Khanka Sea, near Vladivostok Thus the idea of a very high endemism of the Baikal fauna seems to require a revision, the main endemic elements of the fauna are all of fresh water origin, while there are no relics of an ancient marine fauna, as has been suggested by some authors These facts lead L S Berg (*Comptes rendus*, Acad Sci, Leningrad, No 22, 1928) to conclude that the fauna of Lake Baikal has been derived from an upper tertiary fauna of fresh water, or brackish water, basins

EMBRYOLOGY OF *STYLOPS* —J Noskiewicz and G Poluszyński record (*Bull Int Acad Polonaise Sc*, Ser B, 1928) observations on the embryology of the Strepsipteran *Stylops* The egg is poor in yolk and the cleavage total and equal During the fourth or fifth cleavage a nucleus is given off from one of the blastomeres into the central yolk mass, which is clearly delimited from the blastomeres and does not divide although its nucleus undergoes two divisions synchronous with those of the blastomeres After the seventh cleavage the embryo consists of 120 or 124 blastomeres and a quadrinucleate yolk syncytium About the fifth or sixth cleavage the embryo begins to be two layered and the end result of the cleavage is a morula in which the yolk sphere is peripheral This stage is transient, for the cells soon assume a radial arrangement in a single layer with a peripheral yolk mass and a central cavity filled with a granular material secreted by the cells The cells which lie under the yolk invaginate and thus a double layered cup results In the cavity of the cup is the yolk mass, the inner layer is the germ layer and the outer is the envelope, apparently equivalent to amnion + serosa of other insects The germinal disc begins to elongate and the embryo becomes rolled at both ends, and stomodæum and proctodæum are formed Cells proliferated from the end of the stomodæum gradually surround the yolk and form the mid gut, which at a later stage has a tubular connexion with the fore gut, but the proctodæum remains blind The genital cells are differentiated moderately late as an unpaired mass of cells near the proctodæum

FEEDING OF *AUTOLYTUS* —Yo K Okado (*Quart Jour Micr Sci*, Oct 1928) describes the method of feeding of *Autolytus edwardsi*, as observed at Plymouth This polychaet attacks the tentacles and upper portions of the hydranths of *Obelia*, cutting them off with the toothed tip of the chitinous tube of the protruded pharynx The pumping action of the proventriculus, which has a valve at each end, causes the food to be

sucked through the pharynx and driven through the ventriculus (reduced in *Autolytus*) into the intestine The pulsations of the proventriculus are about 120 per minute The muscular elements of the proventriculus are strong columns, which extend radially from the lining epithelium, and slender semi annular bands Each radial column represents a single cell the major part of which consists of undifferentiated protoplasm (with one nucleus), on the periphery of which are the fibrils In each fibril are four contractile zones, three internodes, and two insertion parts The contractile zones only stain with hæmatoxylin, and may be compared with the anisotropic bands of the striated muscle of arthropods

INDIAN HYDRACARINA —A number of fresh water mites have already been recorded from Ceylon and parts of India Dr C Walter ("Zur Kenntnis der Mikrofauna von British Indien II Hydracarina," *Records of the Indian Museum*, vol 30, pt 1, 1928) describes a number of new species inhabiting marshy regions from a collection made by Dr P A Chappuis for the most part from the Punjab and neighbourhood All but one of these belong to known genera, the new genus *Testudacarus* being founded for one species based on one female only Nearly half of the species recorded, however, are new One of these, *Alurus scutelliformis*, has the hind legs armed with peculiar blade like spines somewhat resembling the chelæ in certain annelids Only one male and one nymph of this species were found The paper is well illustrated by line drawings and there is a valuable list in tabular form showing the distribution of all the Hydracarina known from the Indo Australian region, with a good survey of literature on the subject

DEVELOPMENT OF *LEPTOSYNAPTA INHÆRENS* —S Runnström, in *Bergens Museums Årbok*, Heft 1, 1927, has an important paper dealing with the development of *Leptosynapta inhærens* The biology is discussed During the reproductive period the germ cells were shed between 3 and 6 P M daily for about a month There were indications of periodicity in the reproductive activity An account is given of cleavage, and a detailed study is made of the development of the mesoderm, nervous system, mesenchyme, and spicules A barrel shaped larva is produced Comparison is made between this development and that of other Holothurians and consideration is given to the symmetry of the class and to the modifications of the *Synaptidæ*

GENETICS OF THE DUTCH RABBIT —Since 1920 an extended controversy has been taking place between Prof Punnett and Prof Castle regarding the genetics of the 'Dutch' rabbit Prof Punnett now returns to the charge armed with further breeding data (*Jour of Genetics*, vol 20, No 2) These rabbits show a range of colour marking from almost pure white to entirely black. Punnett interprets the condition as due to a major factor P producing the higher grades of pigmentation (and incidentally preventing *heterochromidia iridis*) and two minor factors S and T which are cumulative in effect, showing more pigmentation in the homozygous than the heterozygous condition. The typical Dutch pattern would be represented by $ppSSTT$ Another minor factor N occurs in most self coloured breeds Thus the whole colour series is explained by one major factor and three modifying factors. In place of P, Prof Castle postulates three multiple allelomorphs, Du for self colour, du_d for Dark Dutch and du_w for White Dutch, with certain modifying factors in addition. Castle also believes he has found linkage between Dutch pattern and long Angora hair, which Punnett believes is unproved. The English pattern has been shown by Castle to be closely linked with the Dutch, English × Dutch giving 3 1 ratios in F_2 except for rare cross overs The English rabbit has a factor for self colour *plus* an inhibitory factor I, hence $IIPP$ with certain minor factors By matings with White Dutch, conclusions are drawn by Punnett which support his interpretations The special value of this work lies in the analysis of what appears phenotypically as a more or less continuous series of colour patterns.

POST EOCENE MOLLUSCA OF NORTH WESTERN INDIA —Nearly three years ago we directed attention (NATURE, Feb 13, 1926, p 246) to the publication of the first part of "Descriptions of Mollusca from the Post Eocene Tertiary Formations of North western India," by the late Dr E Vredenburg Now, after inevitable delays, the second part has appeared under the editorship of Mr H M Lahiri (*Mem Geol Surv India*, vol 50, pt 2) It deals with the remainder of the Gastropoda and the whole of the Pelecypoda from the stratigraphical divisions distinguished by Blanford as the Nari, Gaj, and Mekran Close on two hundred species, many being new, are carefully described, some in great detail, and figured from the author's photographs on 22 plates executed by the Survey in most admirable manner There is a good index to the whole volume at the end

SOUTHERN RHODESIAN MINES — The Geological Survey of Southern Rhodesia has published in its *Bulletin* No 13 a number of miscellaneous reports by Mr F E Keep, State mining geologist There are nine of these reports, five of them, namely, those on the Glen Hume and Glen Brook Gold Blocks, the Cactus mine, both in Gwelo district, the Lone Tree mine in Salisbury district, the Belvedere mine in the Belingwe district, the claims of the Parthenon Syndicate in the Hartley district being essentially gold mines, whilst there are also reports on the Belingwe antimony claims, upon the Copper Duke and Golden Duke mines in the Hartley district, upon Devitt's asbestos claims in the Selukwe district, and upon the Neardy mine in the Makoni district, which appears to carry copper and good lead ores Apparently none of these mines is yet in a highly developed condition, and the reports, though extremely valuable for those locally interested in mining, cannot be said to be of any notable general importance

SUPPORT OF UNDERGROUND WORKINGS —The Safety in Mines Research Board has just issued Paper No 45 dealing with the support of underground workings in certain of the more southern coalfields of England, including North and South Staffordshire, Cannock Chase, Shropshire, Leicestershire and South Derbyshire, Warwickshire, Forest of Dean, Bristol and Somerset, and Kent The report gives a quantity of useful information, particularly in respect of the use of steel supports, the value of which is slowly beginning to be appreciated A useful feature is a glossary of the mining terms employed, these differ so much in different parts of England that their inclusion is a distinct advantage, more particularly for those whose experience has lain in the other coalfields of Britain There is a very useful summary of recommendations, some of which are deserving of the widest possible application, because a recommendation such as that "it is a good practice to keep in each district of the mine at least one day's supply of all lengths of timber in use," is a recommendation that might well be extended to all the coalfields of Great Britain, and the same may be said of many of the other recommendations; it is interesting to find that the authors of the report strongly recommend self-adjusting steel props both

for economy and safety, and also state that "when once steel arches are tried their use is generally extended" There is no doubt that the Committee of the Safety in Mines Research Board, which is studying the question of the support of underground workings, is one of the most useful that the Board has yet set up

MADAGASCAR AND ITS OIL LANDS —The mention of oil possibilities of certain countries conjures up all kinds of technical controversy, and it must be said that Madagascar, despite the Indo Asiatic affinity attributed to it by Dr A Wade recently, prompts many conflicting impressions If we admit that "geologically the island is an extension of the fundamental gneissic platform of Africa," which scarcely anyone would be prepared to gainsay, it is a little difficult to reconcile "every other point of view" with this Indo Asiatic perspective drawn by that author during the course of his paper read before the Institution of Petroleum Technologists on Dec 11 last Most of the previous work on Madagascar has emanated from French writers, and it is certainly useful to have a modern English version by one who has spent considerable time in studying the geology of that island But we feel that a more appropriate title for the paper would have been "The Geology of Madagascar," for the author scarcely makes out an encouraging case for its oil possibilities, he is, in fact, indicatively cautious in this connexion, his concluding remark being "None can say that the island is devoid of possibilities in this direction." In so far as oil is concerned, seepages and tar sands occur at Triassic horizons, these overlie Permian beds with characteristic *Glossopteris* flora, in turn resting on the archæan platform The whole sequence, in fact, is strongly reminiscent of south and south east African stratigraphy, equally of parts of Asia, but scarcely of the oil bearing regions of that continent Most of the trials for oil seem to have been unsuccessful, prompted by the Pechelbronn operations, French engineers even had the idea of 'mining' some of the oil sands, but, unfortunately, there existed practically no pressure which would cause flowage, as the rocks were near the surface Our impression is that Madagascar provides excellent territory for geological study, but that commercial possibilities of oil are somewhat remote

CANADIAN FUELS —The Mines Branch of the Canada Department of Mines has recently issued its report of "Investigation of Fuels and Fuel Testing for the year 1926" (Ottawa F A Acland) The report indicates activities designed to promote the more efficient utilisation of fuels, accumulation of analytical data as to present and potential fuel resources, and actual experimental work to discover methods of exploiting fuels in the future There is a draft of instruction for the proper burning of various fuels currently used in the domestic furnace, which requires a technique more exacting than the open grate The analytical work has merely a local interest, but the study of the distillation of oil shales and the treatment of the Alberta bitumen sands has a wider interest The crude bitumen extracted from the sand was in the form of a stubborn emulsion which was successfully resolved It was shown that this bitumen formed promising stock for cracking by the Dubbs and Cross processes for the preparation of gasoline This information is interesting, although the present low prices of crude mineral oil is a bar to development of such processes

THE CORONA VOLTMETER —It is well known that the maximum value of the potential difference between two spherical electrodes at the instant of the disruptive discharge can be computed with an accuracy of about one per cent, provided that the potentials of the spheres at the instant of the discharge are equal and opposite This is one of the standard methods used by electrical engineers for measuring very high voltages A more accurate method is by means of the corona voltmeter, the principle of which was first employed by Prof J B Whitehead, of Johns Hopkins University If two perfectly clean concentric metallic cylinders have a voltage applied between them, and if this voltage be gradually increased, then at a definite value the inner cylinder begins to emit light at its surface, ionisation can be detected and a characteristic sound can be heard The beginning of breakdown can be detected by noticing any of these phenomena A very thorough experimental study of the corona voltmeter by H B Brooks and F M Defandorf is published in the October number of the *Journal of the Bureau of Standards* They find that except in noisy surroundings the aural detection method can be advantageously employed Although a motor generator set was running in their laboratory, yet by using aeroplane head set telephones with a resistance coupled amplifier, they had no difficulty in making accurate measurements Spark over in a corona voltmeter must not be permitted With aural detection the noise made is deafening, and the spark is injurious to the inner cylinder The experiments show that when air at atmospheric pressure is used between the cylinders, then the ratio of their radii should not be less than twenty For commercial work the corona voltmeter as at present constituted seems to be too complicated Its accuracy, however, being in the neighbourhood of 5 in 10,000, leaves little to be desired

FREQUENCY CONTROL BY QUARTZ OSCILLATORS —In the United States, where there are very many broadcasting stations, great care has to be exercised in controlling the frequencies of the radio or carrier waves which they emit so as to avoid interference between them When interference takes place, a high-pitched whistle which may spoil the programme is heard by the listeners The Federal Radio Commission arranges so that the frequencies between any two stations always differ by more than 10,000 cycles The difference frequency nominally, therefore, is not less than 10,000 cycles per second, and this 'beat' note is unobjectionable even if it could be heard Few radio receivers could amplify, and fewer loud speakers could reproduce this note In practice, however, it is very difficult to control the regulation sufficiently accurately to avoid beat notes In the *Bell Laboratories Record* for September, a description is given of the principle of a device used by the Western Electric Co to regulate the frequencies of the radio waves by means of quartz oscillators The frequency of these oscillators depends on their thickness and their temperature The variation of the period of vibration with temperature can be either positive or negative, depending on the cut of the crystal, and varies in amount from about 30 to 80 cycles per million per degree centigrade change in temperature The crystal is ground until the desired frequency is approximately correct The final adjustment is done by controlling the temperature at which the crystal operates In practice the temperature of the crystal is maintained constant whatever the temperature of the room The crystal is enclosed in a heat insulated box and the temperature of the interior is controlled by thermostatic means, the heating circuit being opened and closed by a vacuum relay The frequency of a radio transmitter controlled thermally in this way is stated to be constant within a few parts in a million

The South Africa Meeting of the British Association

ARRANGEMENTS are now actively in hand for the meeting of the British Association in South Africa, in Cape Town and Johannesburg, next July and August, under the presidency of Sir Thomas Holland, rector of the Imperial College of Science and Technology The following sectional presidents have been appointed Section A (Mathematical and Physical Sciences), Right Hon Lord Rayleigh, Section B (Chemistry), Prof G Barger, Section C (Geology), Sir Albert Kitson, Section D (Zoology), Prof D M S Watson, Section E (Geography), Brigadier E M Jack, Section F (Economics), Prof Henry Clay, Section G (Engineering), Prof F C Lea, Section H (Anthropology), Mr Henry Balfour, Section I (Physiology), Prof W E Dixon, Section J (Psychology), Mr F C Bartlett, Section K (Botany), Prof A C Seward, Section L (Education) Dr C W Kimmins, Section M (Agriculture), Sir Robert Greig

Among the many subjects which are already under consideration for lectures and discussions it is probable that the relation between science and industry will take an important place, following upon the subject of Sir William Bragg's presidential address at last year's meeting in Glasgow It is contemplated that discussions on this topic should be initiated at Cape Town and continued at Johannesburg by representatives in the principal departments of science concerned A special programme is being arranged for geological members, in order that they may co operate with the International Geological Congress which will be meeting in Pretoria concurrently with the Association in Johannesburg, and the agricultural members will be afforded opportunity for meetings with their colleagues in the Pan African Agricultural and Veterinary Congress, which also will be sitting in Pretoria at the same time

After the meetings the majority of the visiting members, who are expected to number upwards of 400, will divide into three main parties, each of these will visit the Victoria Falls, and two will afterwards make extended journeys through the Union territory, visiting the eastern Transvaal and Lourenço Marques, in Portuguese East Africa, and terminating their journeys at Durban and Cape Town, respectively The third main party will probably proceed from the Victoria Falls to Beira, visiting en route the ruins at Great Zimbabwe, where it is hoped that Miss Caton Thompson will have brought to a successful issue the investigation of the ancient remains which she is about to undertake at the instance of the Association

The sectional organising committees held their usual joint meetings at King's College, London, on Jan 4, when a number of important subjects were brought under consideration for joint meetings of various sections in South Africa Among these was a general discussion on the conception of life, which it was proposed should be opened by General Smuts Other discussions are expected to deal with problems of special interest to South Africa, such as those connected with deep mine ventilation and with the relation of dust to miners' diseases The geologists, zoologists, and botanists expect to be associated in a discussion on Gondwanaland Educational problems to be discussed include psychological tests in relation to education and vocational guidance, and the teaching of geography, both of which are understood to be of special interest to South African educationists at the present time A discussion on vitamins is contemplated between the chemical and physiological sections

The South African Association for the Advancement of Science, which initiated and forwarded the invitation to the British Association and, through an executive committee, is undertaking the arrangements in South Africa in co operation with the Travel and Tourist Branch of the South African Railways, has issued special invitations to certain distinguished Dutch and other foreign scientific representatives, of whom the following have accepted Prof E J Cohen, Prof W de Sitter, Prof G A F Molengraaf, Prof R Casimir, Prof O Abel, M l'Abbé Breuil, Prof C Dragoni, and Prof A S Hitchcock

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Science Masters Association

CAMBRIDGE MEETING

THE twenty ninth annual meeting of the Science Masters' Association was held at Cambridge on Jan 2-5 The members were accommodated partly in Trinity College, partly in Gonville and Caius The deputy vice chancellor, master of Sidney Sussex College, heartily welcomed the Association to Cambridge The president—Prof A C Seward, master of Downing College—delivered his presidential address on "The Flora of the Carboniferous Period"

As is usual on these occasions, when the Association goes to one of the university towns, many topics which do not appear in the programme were discussed informally Prof Seward broached one of these in the preface to his address, namely, the need for more botanists There has probably never been a time when the demand for trained men in all branches of science has been either so great or so varied as it is to day The staple product, namely, mental ability, is in the schools in quality and quantity sufficient to meet all demands, the willingness to develop it in the best possible way is also there, but somehow the available talent is not being so economically distributed as both schoolmasters and university teachers would wish There are too many potential chemists, not enough biologists, and extremely few geologists

The pressing need of the moment is biologists, and especially pure botanists, and what makes matters worse in this branch is that the already inadequate supply is being depleted to some extent by the claims of forestry, which naturally encroaches more on botany than on zoology

"It would be foolish," said Prof Seward, in his opening remarks to more than four hundred science masters, "not to seize this exceptional opportunity of asking for sympathetic co operation in an endeavour to meet a very pressing need In recent years it has been impossible to satisfy demands from Government Departments and from various other quarters for men qualified to fill administrative and research posts requiring more than an elementary acquaintance with botany At Cambridge we have plenty of men who take botany as one of three subjects in the first part of the Natural Science Tripos, but there is a shortage of men of first rate ability who choose botany as the one subject in the second part of the Tripos

"I have recently circulated a memorandum to tutors and directors of studies drawing attention to the great increase, during the last few years, in the number of well paid and attractive posts in the Dominions, the Colonies, and at home, which cannot be satisfactorily filled because of the lack of suitable candidates May I entreat my colleagues who advise

boys on the selection of subjects at the university to assist, not so much the Cambridge Botany School as the Empire as a whole, by encouraging promising pupils to consider the possibility of making an acquaintance with botany as an alternative to choosing what, to many, would be a more familiar and therefore an easier course—the further study of chemistry, physics, and mathematics ?

"This request is made partly because, in my opinion, a man who takes a degree in science should have some knowledge of a biological subject, but primarily because I am convinced of the vital importance of turning out men who can supply one of the greatest needs of the present day by devoting themselves to the investigation of problems which lie at the root of our national prosperity There are, no doubt, many boys whose mental chords are more responsive to the calls of mathematics, physics, or chemistry than to those of biology the trouble is a disinclination on the part of some schoolmasters to admit the probability that not a few of their pupils who have shown themselves to be competent students on the physics side might, given an opportunity, discover that biology is their destiny The safe course at the university, it may be said, is a continuation of that followed successfully at school I recall a Spanish saying 'Go with God, Your Grace, and may nothing new happen' On the other hand, it is perhaps desirable to encourage self determination, to give all a chance of experiencing the joy of entering a new world, the thrill of a novel quest "

Prof Seward also put in a plea for a little more geology, an extremely modest plea considering the importance of the subject and the fascination that it has for many boys "I dare not suggest the addition of geology to an already overburdened curriculum, though I cannot help thinking that more effort might be made to bring boys into touch with this branch of natural knowledge, either by devoting part of a general elementary course in science to geological talks, or, in suitable districts, by encouraging boys to spend some of their free time, if they have any, in making observations for themselves, in collecting fossils—a by no means contemptible occupation—or by studying the more obvious phenomena connected with erosion and rock building which provide clues to the interpretation of the documents from which geological history is compiled "

A little more autonomy in school certificate and matriculation examinations, or even a little more elasticity in examinations, would do a great deal towards equalising matters University authorities are apt to blame advanced courses in schools, but the trouble begins with the school certificate, which is also the first statutory examination of a boy's university career If he gets credit in chemistry and physics in the school certificate, he is entitled to think he has done something in those subjects and he is reluctant to make a fresh start for the higher certificate, consequently, he does (as he sometimes puts it) chemistry and physics again When he gets to the university, he is still more reluctant to strike out on entirely new lines

When the Science Masters' Association meets, as it does, in alternate years at one of the universities—old or new—the members get what is in reality a short but intensive refresher course, relieved by very pleasant social intercourse University professors and lecturers are astonishingly generous in providing most stimulating lectures, the laboratories and museums are all thrown open, visits to works and attractive demonstrations are arranged The latest useful devices for aiding science masters in their work and the newest books are brought to their notice in the manufacturers' and publishers' exhibition It is difficult to appraise the value of conferences, because they vary so much both in utility and in achievement, but whatever may be said in mild disparagement of the conference habit—the 'talker feast,' as our American colleagues put it—there is no doubt that these meetings of the Science Masters' Association are most stimulating and a powerful antidote to that bane of the schoolmaster's work—stagnation

The next meeting of the Association will be held in London, in January 1930, under the presidency of Prof James C Philip, professor of physical chemistry in the Imperial College of Science and Technology

Whales Landed in Scotland

PROF D'ARCY W THOMPSON has written a most interesting account of the whales landed at the Scottish whaling stations during the years 1908-14 and 1920-27 (*Fishery Board for Scotland Scientific Investigations*, 1928, No 3), including a detailed examination of all the records, illustrated by sketch maps showing the place of capture, and by tables and diagrams, as well as a full bibliography of references to the species

The old Scottish industry was almost at an end when in 1903 the harpoon gun was introduced from Norway and gave a new impetus to whaling The harpoon gun was used in Ireland a hundred years before its re invention by Captain Svend Foyn about 1865 It is apparently, however, not the harpoon gun alone which has made the modern whaling industry, but the gun used with the explosive bullet

A system of licences was introduced in 1908, and full records with measurements are kept of all whales captured Thus a large amount of valuable information is available on which the present paper is based 6817 whales were landed in Shetland and Harris from 1908 to 1927 (excluding the years of the War, and 1919 and 1921, when no whaling was conducted) Seven species are represented, the Common Finner, *Balænoptera musculus*, being the commonest, the Bottlenose, *Hyperodon rostratus*, the rarest In between in order of frequency come the Sei whale, *Balænoptera borealis*, the Blue whale, *B Sibbaldi*, the Sperm whale, *Physeta macrocephalus*, the Nord caper, *Balæna biscayensis*, and the Humpback, *Megaptera longimana*

Of these the Nordcaper or 'Sarde,' the whale of the old Basque fishery, is one of the most interesting For some time it was thought to be extinct, but although never taken in numbers, 69 individuals, 35 males and 34 females, have been captured since 1908, nearly all of which have been landed at the whaling station at Bunaveneader and caught within an area lying to the west and south west of the Hebrides and beyond St Kilda Most of these were taken in 1908 and 1909, and it is shown that there are very definite fluctuations in their occurrence, apparently dependent on variations in Gulf Stream water In those years when the Atlantic overflow to the north east is strongest these whales are scarce and vice versa, probably owing to their tendency to linger on the coasts of Britain when there is little Gulf Stream current to carry them northwards

75 Sperm whales are recorded, all but one being males They do not breed in Scottish waters, and it is thought that these were young bulls which had

been driven out of the herd It is a remarkable fact that the Sperm whales caught in 1911 (when this species was exceptionally numerous) were all very fat, whilst those caught in 1909 and 1912 were very lean, and the Nordcapers caught in 1909 and 1912 showed the same leanness, and yet the diet of the Sperm whale is mainly cuttlefishes, and that of the Nordcaper consists of the smaller planktonic organisms

University and Educational Intelligence.

CAMBRIDGE —A bequest of the value of about £250,000 from the late Mr John Humphrey Plummer, of Southport, is announced The money is to be governed by trustees and is for the endowment of two chairs for the promotion of modern scientific research No details are as yet available as to the conditions governing the trust

LONDON —The following courses of free public lectures, without tickets, are announced "Fatigue," by G P Crowden, at University College, on Jan 14, 21, and 28, at 5, "The Physiology of Reproduction," by Dr A S Parkes, at University College, on Jan 16, 23, 30, and Feb 6, 13, and 20, at 5, "The Chemistry of Some Natural Drugs," by Dr H R Ing, at University College, on Jan 17, 24, 31, Feb 7, 14, and 21, at 5, "Comparative Physiology," by C F Pantin, at University College, on Jan 18, 25, Feb 1, 8, 15, 22, Mar 1, 8, 15, and 22, at 5, "Some Applications of Physical Chemistry to Steel Manufacture," by Dr A McCance, at the Imperial College of Science—Royal School of Mines, on Jan 23, 24, 30, and 31, at 5 30, "Cytology in Relation to Physiological Processes," by Dr R J Ludford, at University College, on Jan 24, 31, Feb 7, 14, 21, and 28, at 5, "The Current Work of the Biometric and Eugenics Laboratories [University College]," by Prof Karl Pearson and others, at University College, on Jan 29, Feb 5, 12, 19, 26, and Mar 5, at 5 30

MORE than a hundred bibliographies of various subjects have now been issued by the National Book Council, 3 Henrietta Street, London, W C 2 These lists of books do not profess to be exhaustive, but each is prepared under the auspices of a body competent to express an opinion on the subject with which a particular list deals One of the latest lists (price *2d*) contains the titles of recommended books on popular science, or introductory to the various branches of science, and is compiled by Mr J B Clark, late head master of George Heriot's School, and approved by the National Home reading Union The list is classified by subjects, and publisher, date, and price are given for each volume It should be a valuable guide to the general reader who wishes to keep in touch with the progress of modern science

A HARVARD YENCHENG Institute of Chinese Studies is to be opened under the supervision of nine directors representing Harvard and Yencheng (Peking) Universities and the estate of the late Charles M Hall of Niagara Falls, New York, who provided an endowment of two million dollars for it The work of the Institute, which will be carried on at both universities, will include research in Chinese history, art, literature, philosophy, and religion, and special attention will be paid to the study of the Chinese language as a key to understanding the history and civilisation of China There are already some fourteen hundred Chinese students in the United States, and numerous scholarships tenable in the United States are provided by the Chinese Educational Mission, while large sums are spent in promoting study and research by Americans in China The new Institute will obviously strengthen the intellectual ties between the two countries

Calendar of Patent Records

January 14, 1822—The lawyer's wig claims its share of the inventor's attention On Jan 14, 1822, there was granted to H W Ravenscroft, of Lincoln's Inn, peruke maker, a patent for his "forensic wig, the curls of which are constructed on a principle to supersede the necessity of frizzing, curling, or using hard pomatum, and for forming the curls in a way not to be uncurled, and also for the tails of the wig not to require tying in dressing, and further the impossibility of any person untying them"

January 15, 1820—During the first hundred years of their existence, pianos, like spinets and harpsichords, were constructed entirely of wood, though the advantages of being able to use thicker and heavier strings had induced many attempts to introduce iron into the frames William Allen, a tuner, and James Thom, the foreman, at Stodart's, one of the leading piano makers in London, were the first to devise a satisfactory solution to the problem, and a patent was granted to them for their iron frame construction on Jan 15, 1820 The patent rights were at once bought by Stodart's and a great step forward towards the modern piano was made

January 15, 1910—The unsplinterable glass known as 'triplex glass,' which consists of two sheets of glass united by sticking between them a sheet of celluloid softened by a solvent such as acetone and subjecting them to considerable pressure, was invented by Édouard Benedictus of Paris His French patent was applied for in August 1909, and the printed specification describing the invention was published on Jan 15, 1910 The British patent was applied for a few days later and antedated to the date of the French application

January 18, 1799—The continuous papermaking machine was invented by Louis Robort, a mechanic in the employ of Didot St Leger, paper manufacturer of Essones, France, a French patent being granted to him on Jan 18, 1799 The French patent rights were assigned to Didot, but the practical application and development of the invention were due to the Fourdriniers of London, who had acquired the English rights from the patentee, John Gamble Although an Act of Parliament was obtained extending the life of the patent to the year 1822, the patent was hotly contested and was finally set aside by the courts on a technical flaw, and the Fourdriniers lost not only their royalties but also the very considerable sum of money they had spent in perfecting the invention

January 20, 1818—The great tunnel enterprises of recent years were made possible by the invention of the tunnel boring-shield by Marc Isambard Brunel, the patent for which is dated Jan 20, 1818 Brunel's shield—the general principles of which are the same as those of the shields in use to-day—was employed for the first time in 1825 for the construction of the Thames tunnel at Rotherhithe, which after long delays due to financial difficulties was finally completed and opened to the public in 1843 No other shield tunnel was built until 1869

January 20, 1820—Labour saving devices have generally had their origin in the United States, and it was here that the standardisation of parts in gun making and their manufacture on the interchangeable system was worked out and fully developed One of the principle inventors in this field was Thomas Blanchard, a descendant from a Huguenot family which settled in Boston in the seventeenth century The United States patent for his lathe for turning gun-stocks was granted on Jan 20, 1820, and such was its importance that it was twice extended by Act of Congress, first in 1834 and again in 1848

Societies and Academies.

LONDON

Geological Society, Dec 5 —**K S Sandford** The erratic rocks and the age of the southern limit of glaciation in the Oxford district The Plateau Drift around Oxford contains rocks brought from long distances from Scandinavia, Scotland, East Anglia, the Midlands, and, most surprising of all, from Devon and Cornwall The Drift entered the district through the Cotswold escarpment by gaps which the northern tributaries of the Upper Thames occupy There is no evidence of glacial erosion of the district within the scarp, though a few patches of Drift are recognised as Boulder Clay It is not suggested that heavy glacier ice was the vehicle in every instance for example, the material from the south west was most probably carried on detached shore ice drifting up the Bristol Channel This material lends support to the view that the southern midlands in particular were submerged to a considerable depth The material, however introduced, was 'graded' or redeposited in terraces up to 350 feet above the recent rivers, this process being subsequent to, and distinct from, the introduction of the Drift into the district The erratics are believed to have been assembled under glacial conditions, evidently over a long interval of time, early in the Pleistocene Period Within the district a threefold glacial sequence is now established The first, the subject of this paper, was the maximum glaciation of the southern midlands and of early Pleistocene age During the other two the district was an ice free land area, between the glaciers of the eastern counties and of Wales The Oxford district being ice free during these later glacial episodes, the conditions which then prevailed are faithfully recorded in the contemporary fluviatile deposits and surface changes The chronological sequence is given

Royal Meteorological Society, Dec 19 —**L H G Dines** The Dines float barograph The instrument designed by the late Mr W H Dines about twenty years ago, which has been in use at the observatories of the Meteorological Office for a number of years, is a pen recording barograph of which the leading feature is the care taken to reduce friction in the mechanism The record will indicate barometric oscillations of amplitudes down to one or two tenths of a millibar —**J Glasspoole** The distribution of the average seasonal rainfall over Europe In western Europe there is abundant rain at all seasons, with a minimum in summer and a maximum in winter In the Mediterranean region there is very little rainfall at all during the summer, while there is generally a preponderance at this season in central Europe In the three months June–August only one fiftieth of the average annual rain falls in the south of Spain, while more than half the annual amount falls in the same period in north eastern Russia

PARIS

Academy of Sciences, Dec 3 —Camille Gutton was elected *Correspondant* for the Section of Physics, and Louis Léger for the Section of Anatomy and Zoology —**Long** A property which appears to belong to prime numbers —**Herbert Ory** The equation $x^n = a$, where a is a square-determinant of the second order —**B Hostinsky** The probabilities relating to the position of a sphere with fixed centre —**C Lurquin** A limit of probability in the Bienaymé Tchebycheff sense —**Vladimir Bernstein** Some theorems on the growth of holomorph functions and the series of Dirichlet —**Paul Lévy** The symbolic calculus of Dirac —**F H van den Dungen** The approximate calculation of the fundamental numbers —**A Zygmund** Conjugated functions —**Alexandre Rajchman** A class of functions with limited variation —**Henri Bénard** Alternating vortices (in liquids) due to knife edge obstacles —**J Haag** Extension of the theory of Saint Venant to elastic wires of any form —**R de Fleury** Aluminium pistons It has been noted that the substitution of aluminium pistons for iron pistons in internal combustion engines leads to a marked increase in the wear of the cylinder The possible causes of this are discussed —**Thadée Peczalski** The kinetic theory of adsorption —**Mlle Marie Kosinska** The Joule Thomson effect and the internal friction of fluids —**Vasilesco Karpen** The Van der Waal's equation and the principles of thermodynamics The Maxwell Clausius relation and the formula of Clapeyron deduced from this equation —**Edgar Pierre Tawil** A new mode of developing electricity by torsion in quartz crystals —**Albert Arnulf** An optical method of localisation of polished surfaces, and its application to the measurement of radii of curvature —**V Posejpal** The fluorescence of benzene and its infra red absorption —**H Barjot** Utilisable natural energy In regions within the Arctic Circle the atmospheric temperature may be from $-25°$ C to $-40°$ C, whilst ice covered lakes have water immediately under the ice layer at 0° C A heat engine with ammonia, carbon dioxide, or sulphur dioxide as working liquid could be worked over this range and used as a source of energy —**Albert and Marcel Gosselin** Constitution and thermochemistry —**Charles Prevost** Some new phenomena of tautomerism in the allyl series Study of the phenomena of tautomerism between compounds of the types C_6H_5 CHX CH CH_2 and C_6H_5 CH CH CH_2X —**J Orcel** Remarks on the measurement of the reflecting power of opaque minerals and of highly refractive transparent minerals A completion of an earlier paper on the same subject with additions on the choice of standard minerals and on the calculation of ω, the angle of maximum rotation of the plane of polarisation of the incident light —**Paul Gaubert** The action of heat and of the loss of water on the optical properties of heulandite An attempt is made to determine the separate effects of rise of temperature, loss of water, and optical anomalies —**Maurice Blumenthal** The existence of the Malaga Betic in the region of Grenada —**A Demay** The prolongation of the Cevennes strata on the western border of the Saint Etienne coal basin —**Pierre Viennot** New geological observations in the Labourd (Basses-Pyrénées) —**Jacques Bourcart and Guy Le Villain** The fauna of the Cambrian limestones of Sidi Mouça d'Agloa, near Tiznit (South Morocco) —**Gustave Rivière and Georges Pichard** The fertilisation of soils poor in lime Comparative trials with various carbonates A description of experiments on the effects of the addition of carbonates of calcium, magnesium, sodium, and potassium to soils, equimolecular proportions being employed In each case the yield of oats was increased, the most marked effect being produced by sodium carbonate, which appeared to act as a true manure —**A Mordvilko** New contribution to the study of anolocycly in the Aphides *Forda formicaria* and its anocyclic form.—**Alphonse Labbé** The experimental production of conjunctive tissue by the amœbocytes in *Doris tuberculata* —**J J Thomasset** An attempt at the classification of the varieties of dentine in fishes.—**André Boivin** Contribution to the study of the chromic sulphuric acid oxidation of carbonaceous substances A general method for the micro-estimation of carbon in the wet way The modifications suggested are a temperature

of 100° C for the moist combustion and a means of burning the carbon monoxide always produced —E Brumpt The identity of the genera *Grahamella* and *Bartonella* —Georges Blanc and J Caminopetros Experiments made in Greece on the mode of transmission of dengue Attention is directed to the fact that the word 'dengue' has been applied to two separate diseases The mosquito *Stegomyia* is infected by the disease and can transmit it in the usual way, mosquitoes of the genus *Culex* do not pass on the infection by stinging —Et Burnet, P Durand, and D Olmer Attempts at the transmission of Marseilles exanthematic fever by lice Attempts to infect apes through the medium of lice gave negative results

Official Publications Received

British

Madras Agricultural Department Year Book 1927 Pp ii+48+5 plates 10 annas Report on the Operations of the Department of Agriculture Madras Presidency, for the Year 1927 28. Pp ii+108+4+6 plates 1 rupee Bulletin No. 92 Mosaic Disease of Sugar Cane By Rudolph D Anstead Pp. 18+2 plates 6 annas Bulletin No 98 Cultivation of Plantains on Wet Lands in the Godavari Delta. Pp ii+8+1 plate 3 annas. (Madras Government Press)

South Australia Department of Mines Mining Review for the Half Year ended June 30th 1928. (No 48) Pp 70+9 plates (Adelaide Harrison Weir)

Tide Tables for the Eastern Coasts of Canada for the Year 1929 including the River and Gulf of St. Lawrence the Atlantic Coast the Bay of Fundy Northumberland and Cabot Straits and Information on Currents in addition to Tide Tables for New York and Boston U S A. (Thirty third Year of Issue) Pp 90 (Ottawa F A. Acland)

Transactions of the Geological Society of Glasgow Vol 18 Part 2 1927 1928 Pp 247 300. (Glasgow) 7s 6d

City of Leicester Museum and Art Gallery Twenty fourth Report to the City Council, 1st April 1927 to 31st March 1928 Pp. 24 (Leicester)

London School of Hygiene and Tropical Medicine Report on the Work of the School for the year ended July 31st 1928 Pp. 32 (London)

Foreign

University of Illinois Engineering Experiment Station Bulletin No 185 A Study of the Failure of Concrete under combined Compressive Stresses. By Prof Frank E Richart Anton Brandtzaeg and Rex L Brown Pp 104 55 cents Bulletin No 186 Heat Transfer in Ammonia Condensers Part 2 By Prof Alonzo P Kratz Prof Horace J Macintire and Richard E Gould Pp. 28 20 cents (Urbana, Ill)

New York Academy of Sciences Scientific Survey of Porto Rico and the Virgin Islands Vol 10 Part 1 *Amphibians and Land Reptiles of Porto Rico with a List of those reported from the Virgin Islands* By Karl Patterson Schmidt Pp 160+4 plates (New York City)

Department of the Interior Bureau of Education Bulletin 1928 No 14 Land Grant Colleges and Universities Year ended June 30 1927 By Walter J Greenleaf Pp v+77 (Washington D C Government Printing Office) 15 cents.

Japanese Journal of Physics Transactions and Abstracts Vol 5 No 1 Pp. 66+14+2 plates (Tokyo National Research Council of Japan)

Proceedings of the Academy of Natural Sciences of Philadelphia Vol. 80 Land Shells of Tortuga Island, Haiti and a new Haitian Oleacina by Henry A. Pilsbry and Edward G Vanatta Review of the Species of Lucidella belonging to the Subgenus Poenilella (Helicinidae) of Haiti and Santo Domingo by Henry A. Pilsbry Pp 475 482+plate 27 (Philadelphia Pa.)

Catalogues etc

Rare Books (Catalogue No 23) Pp 58 (Newcastle on Tyne William H Robinson.)

Calendar for 1929 (Newcastle-on Tyne C A Parsons and Co Ltd)

Nickel Steels Series A No. 2 The Properties and Applications of Invar and related Alloys By C E. Guillaume Translated by R. Rengert Pp. 8. (London The Bureau of Information on Nickel Ltd)

Calendar for 1929 (London Cambridge Instrument Co Ltd)

Calendar for 1929 (London *The Chemical Trade Journal*.)

Récentes publications medicales Pp 64 (Paris Masson et Cie)

Diary of Societies

FRIDAY, January 11

Royal Astronomical Society at 5 —T Royds A Very High Prominence on Nov 19 1928 —J M Baldwin Alignment Chart Connecting Position Angle and Distance of the Apex of the Sun s Way and Galactic Co-ordinates with Equatorial Co-ordinates

Philological Society (at University College), at 5.30 —L C Wharton Dialect Developments.

Malacological Society of London (in Zoological Department, University College), at 6 — E. Ashby Taxonomic Value of Characters in the Order Polyplacophora.—C Oldham *Cepaea hortensis* Mull and *Arianta arbustorum* L. on Blown Sand —Dr H. Engel *Aplysia* (*Tethys*) *dactylomela* Rang, a Circumtropic Species

North East Coast Institution of Engineers and Shipbuilders (in Mining Institute Newcastle upon Tyne), at 6 —W J Drummond Coal used in its Raw State.—Dr W T K. Braunholz Fuels obtained by the Treatment of Coal

Institution of Electrical Engineers (London Students Section) at 6.15 —J A. H Lloyd Telephone Repeaters.

Society of Chemical Industry (Manchester Section) (at Engineers Club Manchester), at 7 —Dr F C Wood Recent Progress in the Study of the Chemical Reactions of Cellulose —N S A Humphries The Efficiency of the Present Day Finishing Stenter —F Scholefield A New Oxygen Carrier for Dyeing and Printing Processes —Dr G N Burkhardt and H Wood The Nitro Aryl Sulphuric Acids and their Reduction Products

Junior Institution of Engineers at 7 30 —F E Webb Developments in Spraying Apparatus

Blackburn Textile Society (at Blackburn Technical College) at 7 30 —Dr P Bean The Dyeing of Artificial Silk

Keighley Textile Society (at Kiosk Café Keighley) at 7 30.—Lecture on Artificial Silk

Society of Chemical Industry (South Wales Section) (at Thomas Cafe Swansea), at 7 30 —A Grounds Preparation of Coal for the Market

Society of Chemical Industry (Chemical Engineering Group) (at Royal Society of Arts) at 8 —Prof B P Haigh The Relative Safeties of Mild and High Tensile Alloyed Steels under Alternating and Pulsating Stresses

Royal Society of Medicine (Ophthalmology Section) at 8 30 —M L Hepburn An Attempt to Classify (Pathologically) the Various Fundus Pictures in Diseases of the Choroid.—M S Mayou Juvenile Glaucoma

MONDAY January 14

Royal Geographical Society (at Lowther Lodge) at 5 —Col Sir Gerald Lenox Conyngham The Cambridge Pendulums for Gravity Survey

Royal College of Surgeons of England at 5 —Sir Arthur Keith A Sketch of the Present State of Knowledge regarding the Evolution of the Brain in Higher Primates

Institution of Automobile Engineers (Birmingham Centre) (at Queen s Hotel Birmingham), at 7 — Dr F W Lanchester Coil Ignition.

Institution of Automobile Engineers (Graduates Meeting) (at Loughborough College) at 7 —E. C Thompson Purchasing

Institution of Electrical Engineers (North Eastern Centre) (at Armstrong College) at 7 —Capt. J M Donaldson J G Hines and others Discussion on The Anticipation of Demand and the Economic Selection Provision and Layout of Plant

Institution of Electrical Engineers (Informal Meeting) at 7 —Major A Jenkin and others Discussion on Electric Trolley Omnibuses

Ceramic Society (at North Staffordshire Technical College Stoke on Trent) at 7 30 —G W S Brewer Pre wheel Pottery—Descriptive of Iron Age Remains from Cleeve Hill, Cheltenham —K Silk and N D Wood The Comparative Effects on Earthenware Slip of Varying Soda silica Ratios in Silicate of Soda

Institution of Heating and Ventilating Engineers (Associate Members and Graduates Branch) (London and District) (at Borough Polytechnic) at 7 30 —A T Henly Timber Drying and Seasoning

Hunterian Society of London at 7 30 —Prof Putti Lecture

Institute of Metals (Scottish Local Section) (at Institution of Engineers and Shipbuilders in Scotland 39 Elmbank Crescent Glasgow) at 7 30. —A Spittle Recent Developments in the Manufacture of Condenser Tubes

Institute of Brewing (London Section) (at Charing Cross Hotel).—J Stewart The Malting Barleys of 1928

TUESDAY January 15

Royal Society of Medicine (Medicine Section) at 5 —Dr F Parkes Weber Endocrine Tumours —Dr O Leyton How can we Decide that a Case of Glycosuria Should be Treated?

Royal Institution of Great Britain at 5 15 —Dr F A Freeth Critical Phenomena in Saturated Solutions (I).

Royal Society of Medicine at 5 30.—General Meeting

Mineralogical Society (at Geological Society of London) at 5 30 —Prof A. Holmes and Dr H F Harwood The Tholeiite Dikes of the North of England —A. Russell On the Occurrence of Gold at Hope s Nose Torquay Devonshire

Institution of Electrical Engineers (East Midland Sub Centre) (at Derby Technical College) at 6 45 —F H Rosencrants Practice and Progress in Combustion of Coal as applied to Steam Generation

Institution of Electrical Engineers (North Midland Centre) (at Hotel Metropole Leeds) at 7 —J L Carr Recent Developments in Electricity Meters with Particular Reference to those for Special Purposes

Royal Photographic Society of Great Britain at 7 — J E B Wright Rock Climbing in the English Lake District

Institution of Heating and Ventilating Engineers (Associate Members and Graduates Branch) (Manchester and District) (at Milton Hall Manchester), at 7 —L Barton Ventilation of Institutions and Public Buildings

Institute of Metals (North East Coast Local Section) (at Armstrong College, Newcastle upon Tyne) at 7 30 —R Dowson Some Aspects of Steam Turbine Development and Application

British Institute of Philosophical Studies (at Royal Society of Arts), at 8 15 —Roger Fry Representation in Art (Lecture)

Royal Anthropological Institute, at 8 30 —Prof R. R Gates Studies of Eskimos and Indians in the Canadian Arctic

Institution of Mechanical Engineers (Swansea Branch) —J W Burr The Electrification of a Small Railway

WEDNESDAY January 16

Society of Glass Technology (at Manchester) at 2 30

Royal Society of Medicine (Surgery Sub-Section of Proctology) at 5 —Clinical Pathological Meeting

Royal College of Surgeons of England, at 5 —Sir Arthur Keith The Growth of the Human Brain and a Discussion as to the Significance of its Mass

Institution of Civil Engineers (Informal Meeting) at 6.—H. H. Dalrymple Hay Merits and Demerits of Alternative Methods of taking Water for Modern Power-Stations from Tidal Waters.

Institution of Electrical Engineers (Mersey and North Wales (Liverpool) Centre) (jointly with Liverpool Engineering Society) (at Liverpool) at 7

INSTITUTION OF ELECTRICAL ENGINEERS (Tees-Side Sub-Section) (at Cleveland Technical Institute, Middlesbrough), at 7.—S. G. Marston, D. G. F. Drummond, and others: Informal Discussion on The I.E.E. Wiring Regulations.
SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) (jointly with Institute of Chemistry), at 7.15.—W. P. Dreaper: Artificial Silk (Lecture).
NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section) (at Newcastle-upon-Tyne), at 7.15.—H. Caird, W. S. Paulin, and others: Discussion on Steam Engine Machinery *versus* Diesel Machinery.
INSTITUTION OF ELECTRICAL ENGINEERS (Sheffield Sub-Centre) (at Royal Victoria Hotel, Sheffield), at 7.30.—T. W. Sampson: The Electrical Engineer and Medical Science.
JUNIOR INSTITUTION OF ENGINEERS (Sheffield and District Local Section) (at Cutlers' Hall, Sheffield), at 7.30.—Lt.-Col. J. T. C. Moore-Brabazon: Early Aviation.
INSTITUTE OF METALS (Scottish Local Section) (at 39 Elmbank Crescent, Glasgow), at 7.30.—A. Spittle: Recent Developments in the Manufacture of Condenser Tubes.
TEXTILE INSTITUTE (Yorkshire Section, jointly with Halifax Textile Society) (at White Swan Hotel, Halifax), at 7.30.—A. Saville: Some New Factors in Industry.
ROYAL METEOROLOGICAL SOCIETY (Annual General Meeting), at 7.40.—Presentation of the Buchan Prize to Dr. Harold Jeffreys.—Sir Richard Gregory: Amateurs as Pioneers (Presidential Address).
ROYAL SOCIETY OF ARTS, at 8.—Prof. C. R. Darling: The Domestic Smoke Problem—a Practical Solution.
ROYAL MICROSCOPICAL SOCIETY (Annual General Meeting), at 8.—J. E. Barnard: Some Aspects of Ultra-Violet Microscopy (Presidential Address).
LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemistry Section) (at College of Technology, Leicester), at 8.—J. P. O'Callaghan: Present-day Methods of Water Softening.
ELECTROPLATERS AND DEPOSITORS TECHNICAL SOCIETY (at Northampton Polytechnic Institute), at 8.15.—D. J. Macnaughtan and R. A. F. Hammond: The Progress of Nickel Deposition in Recent Years.
SOCIETY OF CHEMICAL INDUSTRY (Newcastle Section) (at Armstrong College).—S. A. Wikner: Tar Distillation.
SOCIETY OF CHEMICAL INDUSTRY (Nottingham Section).—F. G. Conyers: The Distillation of Wood.
INSTITUTE OF CHEMISTRY (Huddersfield Section).—Spiropyrans and the Formation of Coloured Ions.

THURSDAY, JANUARY 17.

ROYAL SOCIETY, at 4.30.—Prof. A. S. Eddington: The Charge of an Electron.—R. H. Fowler: The Thermionic Emission Constant A.—J. A. Gaunt: The Triplets of Helium.—G. Temple: The Tensorial Form of Dirac's Wave Equations.—*Papers to be read in title only*:—Prof. H. M. Macdonald: The Reflexion and Transmission of Electric Waves at the Interface between two Transparent Media.—D. K. Bhattacharyya: On the Analysis of the First Spark Spectrum of Sulphur.—C. W. Gibby, C. C. Tanner, and Prof. I. Masson: The Pressure of Gaseous Mixtures (II.).—J. S. Foster: Effect of Combined Electric and Magnetic Fields on the Helium Spectrum.—R. W. B. Pearse: The Ultra-Violet Spectrum of Magnesium Hydride (I.).—J. S. Foster and W. Rowles: Patterns and Paschen-Back Analogue in the Stark Effect for Neon.—J. K. L. MacDonald: Stark Effect in a Violet Region of the Secondary Spectrum of Helium.—J. S. Foster and M. L. Chalk: Relative Intensities of Stark Components in Hydrogen.—J. Chariton and G. A. Lea: (a) Some Experiments concerning the Counting of Scintillations produced by Alpha Particles. Part I. (b) Some Experiments concerning the Counting of Scintillations produced by Alpha Particles. Part II. The Determination of the Efficiency of Transformation of Kinetic Energy of the α-Particles into Radiant Energy. (c) Some Experiments concerning the Counting of Scintillations produced by Alpha Particles. Part III. Practical Applications.—O. R. Baldwin: The Relativity Theory of Divergent Waves.—Dr. G. W. C. Kaye and W. F. Higgins: The Thermal Conductivity of Solid and Liquid Sulphur.—S. Barratt and C. P. Stein: On Bromine Chloride.
LINNEAN SOCIETY OF LONDON, at 5.—Dr. G. Enderlein: Die Copeognathen-Fauna der Seychellen.—S. Maulik: Chrysomelid Coleoptera of the Sub-families Eumolpinæ, Galerucinæ, and Halticinæ from the Islands of the Western Indian Ocean.—Prof. F. E. Lloyd: The Resistance of the Door of the *Utricularia* Traps to Water Pressure.—Dr. A. B. Rendle: A Remarkable Subterranean Orchid from West Australia.
ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Gordon Home: Roman London (I.).
BIOCHEMICAL SOCIETY—UNIVERSITY OF BIRMINGHAM (at Birmingham University), at 5.30.—Prof. A. R. Ling: Presidential Address.
INSTITUTION OF MINING AND METALLURGY (at Geological Society), at 5.30.
INSTITUTE OF METALS (Birmingham Local Section) (at Engineers' Club, Birmingham), at 7.—A. J. Dale: Refractories for Use in Metallurgical Furnaces.
BATLEY AND DISTRICT TEXTILE SOCIETY (at Batley Public Library), at 7.30.—W. F. Vickers: Oils and Wool.
INSTITUTE OF CHEMISTRY (Edinburgh and East of Scotland Section) (jointly with Society of Chemical Industry, Edinburgh and East of Scotland Section) (at North British Station Hotel, Edinburgh), at 7.30.—Dr. J. D. M. Ross: X-Ray Analysis of Crystals.
SOCIETY OF DYERS AND COLOURISTS (Midlands Section) (at Leicester Technical College), at 7.30.—A. J. Hall: Swelling of Fibres.
OPTICAL SOCIETY (at Imperial College of Science), at 7.30.—E. F. Fincham: The Function of the Lens Capsule in the Accommodation of the Eye.—Dr. D. S. Perfect: A Double Reflection Level.—T. Smith, Dr. J. S. Anderson, and L. C. Cordle: Photographs of Reflexion Caustics.
CHEMICAL SOCIETY, at 8.—A. H. Dickins, W. E. Hugh, and G. A. R. Kon: The Chemistry of the Three-carbon System. Part XX. Cyclo-Pentylideneacetone and Cyclopentylidenemethylethyl Ketone.—H. D. K. Drew: Non-existence of Isomerism among the Dialkyl Telluronium Dihalides.—C. S. Gibson and J. L. Simonsen: Indian Turpentine from *Pinus longifolia* Roxb. Part V. The Oxidation of *d*-Δ^3-carene with Beckmann's Chromic Acid Mixture.
ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (at 11 Chandos Street, W.), at 8.15.—Dr. E. Hindle: An Experimental Study of Yellow Fever.

BRITISH INSTITUTE OF RADIOLOGY, at 8.30.
SOCIETY OF DYERS AND COLOURISTS (West Riding Section) (at Bradford).—Prof. H. E. Fierz-David.
INSTITUTION OF MECHANICAL ENGINEERS (Birmingham Branch).—Informal Discussion.
INSTITUTION OF MECHANICAL ENGINEERS (Manchester Branch).—Dr. E. G. Ritchie: Steam Storage.
NELSON TEXTILE SOCIETY (at Nelson).—J. Smeaton: The Testing of Textile Materials and the Work undertaken by the Manchester Chamber of Commerce Testing House.

FRIDAY, JANUARY 18.

TEXTILE INSTITUTE (Lancashire Section) (at Manchester), at 1.15.—J. P. O'Callaghan: Water Softening for the Textile Industries.
ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: The Present State of Knowledge concerning the Cortical Areas of the Human Brain.
SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (at Liverpool University), at 6.—C. Gordon Smith: Common Salt.
INSTITUTION OF MECHANICAL ENGINEERS, at 6.—J. G. Weir: Modern Feed Water Circuits.
INSTITUTION OF CHEMICAL ENGINEERS (at Institution of Civil Engineers), at 6.30.—Prof. J. W. Cobb: The Reactivities of Solid Carbon in Fuel Processes (Lecture).
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group), at 7.—M. O. Dell: Some Recent Prints from the Pyrenees.
GLASGOW SOCIETY OF DYERS (at 7 Gordon Street, Glasgow), at 7.15.—A. J. Hall: The Action of Swelling Agents on Artificial Silk.
JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—J. F. Petree: Notes on the Fitting and Operation of Michell Bearings.
OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section) (at Milton Hall, Manchester), at 7.30.—Dr. J. J. Fox: The Examination of Paints.
ROYAL SOCIETY OF MEDICINE (Pathology, Surgery, and Obstetrics Sections), at 8.—Special Discussion on Post-operative Thrombosis: Openers: W. H. Evans (Pathology), D. H. Patey (Surgery), V. Bonney (Obstetrics).
ROYAL SOCIETY OF MEDICINE (Electro-Therapeutics Section), at 8.30.—C. T. Holland: Epiphyseal Injuries of the Wrist Joint.—Dr. R. S. Patterson: Some Factors Influencing Epiphyseal Growth and Union.
ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Sir William Bragg: Further Progress in Crystal Analysis.
SOCIETY OF DYERS AND COLOURISTS (Manchester Section).—Dr. S. G. Barker: The Standardisation of Fastness of Dyestuffs on Dyed Fabrics.
TODMORDEN TEXTILE SOCIETY (at Todmorden).—H. I. Curtis: Cloth Testing and Examination from the Manchester Man's View.

SATURDAY, JANUARY 19.

GEOLOGISTS' ASSOCIATION (at Museum of Practical Geology, Jermyn Street), at 2.30.—Dr. R. Crookall: Demonstration of Coals: their Composition and Origin.
ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. E. Cammaerts: Flemish and Belgian Art (I.): The Portrait.

PUBLIC LECTURES.

MONDAY, JANUARY 14.

UNIVERSITY COLLEGE, at 5.—G. P. Crowden: Fatigue. (Succeeding Lectures on Jan. 21 and 28.)
EAST ANGLIAN INSTITUTE OF AGRICULTURE (Chelmsford), at 7.—R. T. Parkhurst: Poultry Research.

TUESDAY, JANUARY 15.

GRESHAM COLLEGE, at 6.—A. R. Hinks: Distinguished Stars. (Succeeding Lectures on Jan. 16, 17, and 18.)

WEDNESDAY, JANUARY 16.

UNIVERSITY COLLEGE, at 5.—Dr. A. S. Parkes: The Physiology of Reproduction. (Succeeding Lectures on Jan. 23, 30, Feb. 6, 13, and 20.)

THURSDAY, JANUARY 17.

UNIVERSITY COLLEGE, at 5.—Dr. H. R. Ing: The Chemistry of some Natural Drugs. (Succeeding Lectures on Jan. 24, 31, Feb. 7, 14, and 21.)
BEDFORD COLLEGE FOR WOMEN, at 5.15.—T. A. Joyce: The Architecture of Central and South America.

FRIDAY, JANUARY 18.

UNIVERSITY COLLEGE, at 5.—C. F. Fantin: Comparative Physiology. (Succeeding Lectures on Jan. 25, Feb. 1, 8, 15, 22, Mar. 1, 8, 15, and 22.)

SATURDAY, JANUARY 19.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—D. Martin Roberts: London through the Ages.

CONFERENCE.

FRIDAY, JANUARY 11.

ROTHAMSTED EXPERIMENTAL STATION, at 11.15 A.M.—The Hertfordshire Agricultural Situation: Can it be Improved? Chairman: Sir John Russell.
R. J. Thompson: Agricultural Production in Hertfordshire.
A. W. Street: Poultry as an Adjunct to the Farm (including Marketing of Eggs).
D. Crawford: Labour-saving Machinery as a Means of Lowering Costs of Production.
F. J. Prewett: Improved Methods of Milk Marketing by Pools and otherwise.
R. R. Enfield: The Ministry of Agriculture's Short Term Credit Scheme.
G. Dallas: Agricultural Labour in Hertfordshire.
J. Hunter Smith: The Place of the Oaklands Institute in the County Agriculture.

SATURDAY, JANUARY 19, 1929

CONTENTS

Editorial and Publishing Offices
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What is Life?

OUR knowledge of the past history of life upon earth, obtained from studies both of the earth's crust and of the organisms which are found inhabiting it at the present time, suggests that living beings developed from non-living material, the organic from the inorganic But the conditions on the surface of this globe must have been widely different from those which obtain at the present day, and the question whether life can arise from the non living to day is still unanswered It is generally held that the evidence indicates that a living organism can only arise from another living being, experiments favouring the view that spontaneous generation does occur having failed to withstand the strictest tests of criticism

The answer to this question, however, depends on the definition of the terms 'living' and 'non living', at first sight the distinction between the two appears sharp and unmistakable, but a little consideration shows that certain living organisms show many analogies with non living material, and that on the borderland of life it may be difficult to say with certainty whether any given material is 'alive' or not To the analogies between live and dead things and their possible implications, Prof A E Boycott devoted his recent presidential address to the Section of Pathology of the Royal Society of Medicine, a revised version of which we publish as a supplement this week Such a comparison is useful, since, although chemistry and physics have helped greatly in the interpretation and understanding of the mechanisms of living organisms, they have not yet succeeded in explaining life

A living organism is an entity, a discrete unit, the live world is made up of such discontinuous pieces But though at first sight the dead world may appear continuous, it also in reality is composed of particulate matter and energy, molecules, atoms, quanta Ultimate analysis has merely led to the discovery of smaller particles, and a fractional atom is as impossible as a fractional animal

Again, the origin of one species from another in the course of evolution has its modern analogy in the derivation of one element from another, apart from the time factor, chemical elements are not necessarily more stable than zoological species, lead or a dog may not always have been so, and cannot be trusted to be so indefinitely in the future It is even possible that as the disintegration of radioactive elements cannot be controlled, so also may the evolutionary sequence of animals be predetermined, although the actual course may be

deflected by changes in the environment Both elements and species can be arranged in groups according to their general characteristics, the position in the table indicates their properties or characters and gives a clue to their past history

The capacity of self repair is one of the greatest characteristics of living beings, a multicellular organism repairs injury by the growth of certain cells usually specifically set aside for this purpose and endowed with the capacity of growth and proliferation, even though some of the cells actually injured die and are not replaced Whether an injured unicellular organism, such as a bacterium, ever undergoes a similar process of repair is more doubtful, it is more probable that the repair is reflected in an increase in the numbers of the race rather than in a recovery of the individual Atoms are continually losing electrons, as, for example, when electrical energy is manifested, but they do not change in nature so that repair, the picking up of an electron, must take place

The variations among the organisms of a single species are obvious enough, and it is known that atoms show a similar variability, and that the atomic weight is merely the mean value for the whole species Biological measurements made on a similar scale to physical or chemical might result in biology also becoming an 'exact' science

A further analogy between the living and the non-living can be drawn from the examination of the courses of the reactions in the hydrolysis of cane-sugar by dilute acid and the destruction of bacteria by heat or disinfectants Both follow a similar path, the bacterium behaves as the molecule of cane-sugar, the proportion killed or hydrolysed depending on the number of organisms still living or on the number of molecules still unchanged The organism acts as the unit If the molecules of the organism were the units and had been destroyed according to the same law, it would have been expected that a stage would have been reached when all the organisms would have died together, whereas, in fact, this destruction only occurs gradually

There is difficulty however, in finding an analogy to reproduction in animals Reproduction appears to be necessary because organisms are unstable, without it they could not maintain themselves But provided that conditions remain constant, the number of any given species does not change greatly from year to year, the capacity for reproduction enables organisms to adapt themselves to varying conditions rather than to increase, except perhaps slowly, in numbers The simpler units of the inorganic world are more stable and do not need therefore to reproduce But if speculation embraces the universe rather than the earth alone, it appears possible that the disintegration of atoms into radiation in the immense heat of the stars may be accompanied elsewhere by the regeneration of matter from energy under conditions of intense cold, giving a true reproduction of inorganic material, and the atoms formed need not be the same as those from which the protons and electrons originally came

It thus appears that living and non-living form one continuous series, and that no sharp distinction can be drawn between them But if so, what sort of matter forms the borderland between the two? Is it the filtrable virus, the bacteriophage and similar agents? These bodies show some of the properties both of bacteria and of non-living matter It is probable that the average diameter of the viruses is about 25 $\mu\mu$, whilst that of the smallest known bacillus is about ten times greater, just at the limit of visibility Organisms of this small diameter can pass through filters, and are about equal to the colloidal aggregates of dissolved hæmoglobin in size and can contain from 200 to 400 protein molecules There appears to be a break in the series of micro organisms between bacteria and viruses, perhaps analogous to the fact that even the smallest mammal has a very definite size The range in size in the bacterial group is of the same order as in the mammals, and the ultramicroscopic viruses may show a similar range The composition of the latter is unknown, it is probable that protein is present, since a virus infection frequently gives rise to a long lasting immunity, on the other hand, provided a minimum dose is given, the severity of the infection is little altered by giving doses even many thousands of times greater, viruses apparently do not produce poisonous substances as do so many bacteria

Many viruses are extremely resistant to destructive agents, others are much more delicate But, unlike bacteria, no virus has been successfully grown in artificial culture without the presence of other cells, in fact, they seem to multiply only in the presence of living cells and preferably young growing cells It is quite possible that they are obligatory intracellular parasites and that this habit of life may explain some of their peculiarities

Though, however, the viruses are related to the bacteria in some of their characteristics, they also show phenomena analogous to those produced by material which is usually considered to be non-living Thus the products of autolysis of dead

cells stimulate growth as well as an agent obtainable from malignant tumour cells The presence of the latter is indicated when malignant epithelial cells stimulate normal connective tissue cells to grow into a transplantable tumour, a carcinoma stimulating the development of a sarcoma This agent is presumably usually very labile, but in the case of the Rous fowl sarcoma can be obtained in the filtrate from the growth and initiate a tumour on injection into another bird, no living agent can be seen or cultivated in such a filtrate

The products of autolysis are 'dead' or non living Is the Rous agent living, or simply a non-living material which can stimulate certain cells to pathological overgrowth? It multiplies only where its specific activity is displayed, and it may survive drastic methods of purification There is good evidence that tumours produced by chronic irritation contain a carcinogenic 'virus', that is, the irritation stimulates the cells to overgrowth, with the result that they produce the virus Hence the latter arises *de novo* in each tumour in the growing cells, and the means of propagation of the disease are not the same as those by which it was originally started

Applying such reasoning to the true virus diseases, for example, foot and mouth disease, the question arises whether the disease may not itself produce the virus, in other words, although the infection is spread by a minute dose of virus, multiplication only occurs in the presence of the specific lesion, so that the virus obtained from the lesion need not be the direct descendant of the infecting virus, in the same way as bacteria only arise from pre-existing organisms In spite of difficulties, epidemiological, immunological, and other, against this view, there are items of evidence in its favour, such as the production of a transmissible inflammatory disease of the rabbit's testis, by inoculating a filtrate of testis emulsion from one rabbit into another's testis, although compounds from an animal's own tissues do not usually behave as antigens in the same animal, there are exceptions to this rule Lysozyme, again, has many of the properties of an enzyme, but it is increased in amount when it acts upon its specific micrococcus

It is therefore possible that viruses are pieces of living cells, which apart from their proper environment have abnormal actions, in this case harmful, since those with the harmful actions are the more easily apprehended They would therefore form part of a continuous series stretching from obviously non-living matter through the growth promoting substances, the viruses, and the bacteria to the higher plants and animals But even if such substances can be considered as both living and arising *de novo* under the appropriate stimulus, the problem of their evolution into a higher microbe is still unsolved, and the conditions for this evolution may not obtain on the earth at the present time, whilst if they are held to be non living, there appears to be no trustworthy evidence that life can arise except from living matter Science still has far to travel before even the humblest bacillus can be produced at will

Wild Nature and Gentle Savages

Wanderings in Wild Australia By Sir Baldwin Spencer Vol 1 Pp xxviii + 455 + 210 plates Vol 2 Pp xiv + 457 930 + 194 plates (London Macmillan and Co, Ltd, 1928) 42*s* net

NO one has done more valuable work in elucidating the ethnography of the aborigines of Australia than Sir Baldwin Spencer, and therefore a new book by him deserves careful consideration "Wanderings in Wild Australia" is possibly the final record of travels and field work begun thirty-four years ago and continued at intervals until within a few years The area of the wanderings is, roughly, between 132° and 136° E long, and from Lake Eyre in the south to Bathurst Island and the Gulf of Carpentaria in the north

The first two parts of the present work closely follow the information given in "Across Australia," by Spencer and Gillen (1912), together with ethnographical additions which are to be found in "The Native Tribes of Central Australia," by Spencer and Gillen (1899), and the new and improved edition of "The Arunta" (1927), which has already been noticed in NATURE (Mar 17, 1928, p 411), as well as observations from 'The Northern Tribes of Central Australia," by Spencer and Gillen (1904) The third part deals with the Kakadu of the East Alligator River (Arnhem Land), Port Darwin, and Melville and Bathurst Islands, the ethnographical matter being abstracted from "The Northern Tribes of the Northern Territory of Australia," by Baldwin Spencer (1914) It will thus be seen that the fortunate possessor of the earlier books will have little occasion to consult the new book so far as anthropological information is concerned, but attention must be directed to the fact that there are a few new photographs which illustrate parts of ceremonies, and several new representations of the very interesting carved and painted grave posts of Melville and Bathurst Islands Those interested in gesture language (vol 1, pp 436 444) will find

nineteen additional signs in "The Arunta," vol 2, Appendix F There are several new sketches, mainly of scenery, by the author, and three or four new maps and two instructive block diagrams showing the relation of the geology of the scenery of the Macdonnell Range

The foregoing is written from the point of view of an ethnologist, but there is another aspect from which the book may be judged The author gives records of various journeys which bring before the reader a vivid picture of the geographical and biological conditions from south to north of the central belt of Australia, and as he was the professor of biology in the University of Melbourne, we have the satisfaction of finding the plants and animals correctly identified The great differences in the flora and fauna and in the country itself during a dry spell from those immediately following a fall of rain account for the diverse opinions expressed by travellers in the past We are told how certain plants and animals adapt themselves to these very contrasted conditions—of succulent and spiny plants, of the æstivation of animals, and of the frogs which are dug up by the natives in the dry season in order that the latter may drink the water with which the frogs have distended themselves

So from stage to stage we are pleasantly conveyed, and learn how travellers and settlers fare in those remote and often most inhospitable regions, and the information is appropriately illustrated by numerous beautiful photographs of scenery and vegetation, with a few representations of animals In this way the stage is set for the human performers in the drama of Australian physical and biological conditions

Most travellers have come across only small bands of wandering natives, with few and crude belongings, who were wresting a precarious living from niggard Nature, and not unnaturally a common opinion has arisen that the people are a miserable, poor, and cultureless folk But, thanks to the researches of Sir Baldwin, we now know that on stated occasions the natives assemble from far and wide to spots where water and food are temporarily abundant, and then the dull, isolated, secular life is exchanged for a period of happy social intercourse and the performance of numerous spectacular religious performances It is impossible to give even a summary of the wealth of information here given concerning these most interesting ceremonies, which, by the way, are fully illustrated by excellent photographs The reader of the book will get, as he cannot obtain anywhere else, a picturesque but scientific account of the daily life, social organisation, ceremonial life, magic, religion, death, burial, and mourning of various tribes, nor are the objects they make and the method of their manufacture neglected

Towards the end of 1911, the Minister for External Affairs of the Commonwealth Government wisely appointed Sir Baldwin Spencer as Special Commissioner for Aboriginals of the newly established Northern Territory, and in the chapter entitled "Work in Darwin" we have a hitherto unpublished account of the first two months of his actions as Chief Protector in charge of the department instituted to safeguard the interests of the aboriginal population This very interesting chapter shows how necessary such an appointment was, since the natives were being hopelessly demoralised by Chinese and Malays The Commonwealth Government has shown in this way, and in appointing a Government anthropologist for the Mandated Territory of New Guinea, that it appreciates the practical value of ethnology, as indeed the Government of Papua has done for many years

A C HADDON

Marine Engine Practice

Marine Engineering in Theory and Practice a Complete Text Book on Heat Engines and Mechanical Engineering connected with them, including Steam Engines and Boilers, Turbines and Internal Combustion Engines and Auxiliary Machinery, both in their General Application and in particular Reference to Types used and to Practice at Sea, for Marine and other Engineers, and Naval Architects, Officers, Apprentices, and Students By Eng Comdr S G Wheeler Vol 1 *Elementary* Re issue with Appendix Pp xi + 182 + 8 Vol 2 *Applied* With a Special Chapter on Metals and Strength of Materials, by Comdr G C Malden Pp xi + 183 597 (London Crosby Lockwood and Son, 1928) Vol 1, 10s 6d net Vol 2, 35s net

THE principal part of Vol 1 of Wheeler's work is devoted to an explanation of the elementary theory of heat engines and of the fundamental principles of their action There is nothing new in the subject matter, but the treatment differs from that ordinarily adopted It is intended for the primary education of engineers engaged in the naval and merchant services, and the style has been modelled to suit Throughout, the aim is to impart a sound grasp of the rudimentary principles, rather than to describe exact methods of calculation Elaborate mathematics are carefully avoided

and diagrams used freely The reader is always encouraged to visualise what actually occurs during any operation that is being explained, and tentative theories and analogies are resorted to in order to facilitate explanation

To the trained engineer, some of the attempts in this direction appear at first to be somewhat crude, but their effectiveness has no doubt been proved in a wide experience in teaching this subject The diagrams employed are those which give the simplest and most direct representation of the function or performance concerned The pressure–volume chart is used wherever possible, and the temperature–entropy chart, which the more advanced student would in many instances find more convenient, is studiously avoided However, the employment of the pressure–volume chart in connexion with unrestricted expansion of steam, while useful as a connecting link between the cases of restricted and unrestricted expansion, is not the most satisfactory for representing the energy transformation of the latter Diagrams showing the losses which occur in the various transitional stages between the burning of the fuel and the development of power on the propeller shaft are particularly useful

Generally speaking, the attempt to present the case in a simple and easily understandable manner is commendably successful, but a few suggestions might be made for a future edition The means adopted for the purpose of getting the reader to appreciate physical facts and functions rather than abstract formulæ, lead to some redundancy, and while this, as a consequence, is probably inevitable, its effect could be largely counteracted by effective summarisation The statement is made that it is impossible to obtain a steam velocity greater than the velocity of sound with a nozzle which has no divergence at outlet This is quite a common mis statement of fact in books of this kind, and yet in actual pressure compounded impulse turbines such nozzles are quite commonly employed for pressure drops greater than the critical

In some cases where values are given by way of example, it should be made clear that they are not absolute and are liable to considerable variation in practice For example, it is stated that the 'design factor' or ratio of work actually obtainable to that which the pressure–volume diagrams show to be theoretically available should be taken as 0 49 for triple expansion reciprocating engines This factor, of course, varies over a wide range for different engines and conditions Again, it is stated that for the steam consumption rate of marine turbines a value of 14 lb per shaft horse power per hour may be taken, whereas there are actually on service at the present time marine turbine installations operating with a steam consumption rate of approximately half that value

However, the general treatment of the subject is good, and the book should be much appreciated by young engineering students and those responsible for their education

The major portion of Vol 2 is devoted to describing systems of marine propulsion and types of engines, boilers, and accessories The description is of a very practical nature, is very well done, and accompanied by a large number of excellent illustrations The first chapter deals with turbines, and commences with a very logical classification of all types, land turbines being wisely included for the sake of completeness The principle of operation and the practical features of the various types are then separately described, and a large number of actual examples illustrated This is followed by a similar description of the most important constructive details The special requirements for ship propulsion are then discussed, and the chapter concludes with a useful review of recent tendencies in practice and design The means which have been adopted for reducing the loss due to the velocity of the steam leaving the final stage are very fully examined, although this is primarily a land turbine problem

Internal combustion engines are dealt with in a similar manner in the next chapter, which commences with a proper classification and then proceeds with the description of the principle of operation, and the constructional features of each type The special apparatus required to meet marine requirements, such as reversing gear, are then dealt with, and 'heat engines reversed,' or refrigerators, are included in this section There is no corresponding chapter on reciprocating steam engines, the treatment of which in the first volume is presumably deemed sufficient The chapter on ship propulsion gives a brief account of the laws of resistance of ships and the action of the screw propeller, and then describes a large number of arrangements of propelling machinery of various types The methods which have been adopted for gearing the engine shaft to the propeller shaft, namely, mechanical, electrical, and hydraulic, receive appropriate attention, and torsion meters are also included

In the chapters on boilers, every type which has been used at all extensively in either land or marine practice is suitably illustrated and described, with

the most important boiler room auxiliaries The chapter on feed water, etc, opens appropriately with a full discussion on the necessity of and methods for preserving boiler feed water from impurities, after which, condensers and their auxiliaries are dealt with This concludes the purely descriptive portion, and its comprehensiveness may be gathered from the above résumé and from the fact that this portion of the book contains more than 300 illustrations

The treatment of the subject of combustion is very thorough, both from the theoretical and practical point of view, and the chapter on metals, etc, takes an excellent survey of the factors which influence the physical properties of the metals ordinarily employed in engineering structures The last chapter describes various steam charts and their uses, and the book concludes with a supplementary set of examples, exercises, and explanatory notes

Taking into consideration the time which the collection of so much matter must have occupied, and the recent rapid progress in marine engineering, the book is remarkably well up to date A few of the examples illustrated are obsolete types, but have been wisely included in order to show on what lines progress has been made In a future edition, reference could with advantage be made to the recent development of high pressure and temperature geared turbine installations, to the combination of reciprocating engines with exhaust steam turbines geared to the same propeller shaft, to the development of the double acting internal combustion engine for large powers, and to the experimental work which has been done in connexion with internal combustion turbines

This volume should prove useful both for text book and for reference purposes

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Evolution

(1) *Charles Darwin the Man and his Warfare* By Henshaw Ward Pp viii + 472 + 27 plates (London John Murray, n d) 21s net

(2) *The Evolution of Charles Darwin* By George A Dorsey Pp xii + 300 (London George Allen and Unwin, Ltd, 1928) 7s 6d net

(3) *Darwinism and What it Implies* By Prof Sir Arthur Keith (The Forum Series, No 8) Pp vii + 56 (London Watts and Co, 1928) 1s net

THE large number of publications which have made their appearance during the last few months upon the subject of evolution affords interesting evidence of a growing appreciation on the part of the general public of the importance of some acquaintance with the general conclusions of biological science as part of the mental equipment of the ordinary citizen

(1) Mr Henshaw Ward's "Charles Darwin the Man and his Warfare" is a book of quite unusual merit The professional biologist will while away a few hours in its perusal with much pleasure, while the layman interested in Darwinism will gain from it a vivid picture alike of the personality of the master and of the various steps in the long campaign which culminated in the conversion of the intellectual world to belief in evolution The author, while apparently not a specialist in biology, shows a wide acquaintance not merely with the works of Darwin himself but also with the writings of others about him and his philosophy, and about his chief contemporaries in the world of science, and this has enabled him to form in his mind a peculiarly vivid picture of Darwin's personality and surroundings—a picture he puts before us with much literary skill in the book under review

The book is really a scientific biography written for the general reader In its fourteen chapters the life of Darwin is divided up into contrasted sections "A Year with Fitz Roy and Lyell," "Six Years of Coral Islands and Species," "Eight Years of Barnacles," "Writing the 'Origin,'" 'The Reception of the 'Origin,'" "Darwin's Life after 1850," are chapter headings which will give an idea of the general plan of the book What they give no idea of is the lively and graphic style in which it is written, or the remarkable vividness of the picture of Darwin and his life which they call into being in the mind of the reader The book is not merely a picture of Darwin himself and his doings it also brings in excellent portraits of those of his contemporaries who played important parts in relation to it Hooker was "a brawny tar, with a handshake like a taut sheet, and a laugh like a favoring gale" An odd figure he was The head was prone to be cocked at a sort of owlish angle for careful inspection of whatever came into view" "Such a handling of men in a complicated situation [during his travels in Sikkim] is good training for the battle at Oxford in 1860" Lyell, Huxley, Owen, Wallace, are all faithfully portrayed "There was in Wallace's nature a beauty that will shine when the splendour of Agassiz and the greatness of Lyell are dim He never laid claims to more honour than the Linnean paper gave him, and so gained a higher kind of fame than scientific discovery can bring"

As may have been gathered, the language in which the book is written is the American variety of English, but any little peculiarities that jar on the purist in literary style may well be pardoned for the sake of the end result an extraordinarily readable and useful book It is, by the way, provided with numerous and excellent illustrations

(2) Dr George A Dorsey is well known as the author of "Why we behave as Human Beings," a book which in the United States enjoys deservedly a big circulation, giving as it does an excellent sketch of those results of modern physiology which are of greatest importance to the ordinary citizen Dr Dorsey has now published a book entitled "The Evolution of Charles Darwin" "To understand Darwin is to understand human beings," he says in his preface, and the whole book is a study of Darwin as a human being It is well done, and in parts is charming, such as the chapter on Darwin as the father of his family, where the author recalls the little daughter running downstairs with the stolen pinch of snuff for her father, and the four year old son approaching him with a bribe of six pence to induce him to come and play during working hours The book is interesting and well worth reading, though many a biologist will demur to the statement that Darwin became a man of science "in spite of his germ plasm," and many a Trinity man to that which attributes to Christ's the honour of having nurtured Isaac Newton

(3) Sir Arthur Keith's 'Darwinism and What it Implies" is a sequel to his earlier volume in the Forum Series, "Concerning Man's Origin," and deals with some of the bearings of Darwinism upon problems of everyday life The nature of mind, foundations of human nature, problems of sex, the spirit of competition, are headings that catch the eye "Every fact known to them [medical men] compels the inference that mind, spirit, soul, are the manifestations of a living brain, just as flame is the manifest spirit of a burning candle" In this connexion the old fashioned philosopher may well ponder over the fact that by drugging the brain we can "alter the mentality" of any man or woman The chapter has in it much that is wise, and scattered through its pages are shrewd sayings "The day man becomes a perfectly rational being marks his end" "To extinguish the spirit of competition is to seek for racial suicide" that spirit "has lifted us from savagedom, and our hopes of the future are bound in it"

The short middle chapter of the three concerns itself with "The Nature of Man's Brain," while the third, "Modern Critics of Evolution," is a reply to articles in the *Nineteenth Century* by Mr George H Bonner and Prof J A Fleming It may perhaps be doubted whether such articles merit even the small expenditure of Sir Arthur Keith's time involved in replying to them Anyone desiring trustworthy information as to what is known of the evolution of the animal kingdom will surely turn to those whose life's work is the investigation of the subject It may be of psychological interest to learn what some distinguished biologist thinks about one of the great generalisations of physical science, or conversely, what a distinguished worker in one of these sciences thinks about the evolution of plants or animals, but it is of no particular moment otherwise While it is no doubt true even to day that there are many men of letters entirely unacquainted with the facts which demonstrate the evolution of man, surely there are few so oblivious of their limitations as to assert dogmatically with Mr Bonner 'There is not a shred of conclusive evidence for the animal ancestry of man"

Our Bookshelf

(1) *Heat, Light and Sound for School Certificate Students* By E Nightingale (Bell's Natural Science Series) Pp xiii + 381 + ix + 11 plates (London G Bell and Sons, Ltd, 1928) 6s 6d
(2) *Sound for School Certificate Students* By E Nightingale (Bell's Natural Science Series) Pp ix + 273 381 + ii (London G Bell and Sons, Ltd, 1928) 2s 6d

(1) THE author of this little text book is to be congratulated His aim has been "to cover the school certificate and matriculation syllabuses in Heat, Light, and Sound in a manner which will appeal to the student" In this aim he certainly appears to be very successful The subject matter contains the latest available information, obtained from the most trustworthy sources The whole is presented in an instructive and attractive manner The illustrations alone are worthy of special mention, in many cases being self explanatory and thus relieving the text of an unnecessary burden The author has not forgotten the historical side of the subject, and short biographies and experiments of famous physicists have been introduced in appropriate places

Experiments which 'work' are well described, and there is little excuse for failure to repeat them An excellent feature of the book which must be noticed is the delightful selection of homely and *effective* illustrations and examples Some of these are reminiscent of Bragg's "World of Sound," and the author has been wise in following the example of such an eminent leader

Mr Nightingale's effort is an example of what a text book for young students should be The information it contains is accurate and up to date

and is presented in the style of an experienced teacher It can be recommended unreservedly to teachers and students as an excellent text-book

(2) This little book is one of a set of three written for matriculation and school certificate students It forms Part III of the combined text-book mentioned above

The Protamines and Histones By the late Prof Albrecht Kossel Translated from the original German Manuscript by Dr William Veale Thorpe (Monographs on Bio chemistry) Pp xi + 107 (London, New York and Toronto Longmans, Green and Co, Ltd, 1928) 9*s* net

It is indeed fortunate that Prof Albrecht Kossel was able to complete the manuscript of this little volume before his death, since more than any other single investigator he had contributed greatly to our knowledge of these two groups of protein compounds The protamines, the simplest known proteins, are characterised by yielding on hydrolysis only about four different amino acids, whereas about twenty units may be obtained from a typical complex protein Moreover, the amino acids found are chiefly those of basic character, arginine, lysine, and histidine The protamines are found solely in the sperm and testicles of certain fish The histones are more complex, containing a greater variety of units, they are, however, like the protamines, of a basic nature They are found in the ripe sperm of certain vertebrates and invertebrates, including some fish, as well as in the nucleus of the red blood cell of the bird and in the thymus gland of the mammal Both protamines and histones occur in Nature in combination with nucleic acids

The monograph describes in detail the methods available for the preparation of these compounds and the separation of the various units after their hydrolysis Separate chapters are devoted to a description of the various individuals of these two groups which have so far been isolated as chemical individuals The importance of the study of such proteins lies in the light which it may shed on the composition and origin of the more complex of these nitrogenous compounds Although primarily a work for the specialist, the volume has an interest also for those who wish to know something of a group of compounds which are not usually considered in much detail in text books of bio chemistry The bibliography extends to upwards of two hundred references

Leached Outcrops as Guides to Copper Ore By Augustus Locke Pp vii + 175 + 24 plates (London Baillière, Tindall and Cox, 1926) 22*s* 6*d* net

The object of this book is stated by the author to be the task of "reconstruction of the sulphide formerly existing" In the majority of cases a deposit consisting of iron pyrites closely intermixed with chalcopyrite or other copper ores, and possibly also other sulphides, does not often come up to the surface in this form, but is usually overlain by a capping, sometimes of very great thickness, of the oxidised products of this ore, and the problem which the author desires to investigate is that of predicting from the nature of the capping the character and richness of the primary ore He has turned his attention mainly to disseminated deposits and has practically neglected the massive ones, which are by far the more important on the continent of Europe The result is that the book is, to use the author's words, "overwhelmingly American", obviously the complete study of the subject would have included an investigation of the cappings of such deposits as the cupriferous pyrites of Huelva and those of Sulitelma and other Norwegian occurrences, about which there is in fact a great deal known

The author has gone into very much minute detail, more especially as to the character and appearance of the limonite which generally results from the oxidation of iron pyrites, but it cannot be said that his results are of any very general use As he himself says "The kind of capping that means ore in one district, does not necessarily mean ore in another" Obviously, if this statement is true, and there is little reason to doubt it, of two districts in the western United States, it applies with even greater force to more remote regions or to other continents The author appears here and there to realise that his theoretical methods are of little real value, and most mining engineers will concur in his dictum

Farm Soils their Management and Fertilization By Prof Edmund L Worthen (The Wiley Farm Series, edited by A K Getman and C E Ladd) Pp x + 410 (New York John Wiley and Sons, Inc, London Chapman and Hall, Ltd, 1927) 13*s* 6*d* net

Under modern systems of farming, it is recognised that soil management must be considered in relation to the specific crops to be grown, and the present volume attempts to correlate the various farm operations with economic crop production The management of any soil will necessarily vary with the type of crop, as treatment that is merely adequate for fruit or garden produce might be hopelessly extravagant and uneconomic for large scale field crops

Prof Worthen keeps the practical aspect in view throughout, and by means of 'community studies' the student is led to investigate problems in the field for himself and to consider the best means for their solution The main farming operations are dealt with in detail from various aspects, chapters being devoted to water supply, tillering, manuring, liming and green manuring The correlation between soil management and the crop grown is brought out by short accounts of the appropriate treatments for field, pasture, garden, and fruit soils, and emphasis is laid on the importance of the cultivator becoming as familiar as possible with the local practices of his district Special care has been taken with the illustrations, which are selected to bear directly upon particular points in the text, and numerous references, solely of American origin, are also included

Lehrbuch der Protozoenkunde eine Darstellung der Naturgeschichte der Protozoen, mit besonderer Berücksichtigung der parasitischen und pathogenen Formen Begründet von Franz Doflein Neubearbeitet von Prof Dr Eduard Reichenow Fünfte Auflage Teil 1 *Allgemeine Naturgeschichte der Protozoen* Pp iv + 436 Teil 2 *Spezielle Naturgeschichte der Protozoen* Hälfte 1 *Mastigophoren und Rhizopoden* Pp iv + 439 864 (Jena Gustav Fischer, 1927–1928) Teil 1, 21 gold marks, Teil 2, 22 gold marks

DOFLEIN'S text book of Protista has been for many years the classical volume for students of protozoa Owing to the number of recent contributions to the literature of this subject, the last edition published in 1916 rapidly became out of date The new volume, of which the first two parts have appeared rearranged and edited by Prof Eduard Reichenow, is therefore a welcome production In the main it follows the lines laid down in the fourth edition, but new sections have been introduced, such as a brief account of the comparatively new subject of soil protozoology The first part ends with an account of the physiology of protozoa, and it is unfortunate that, in common with so many other modern text books, this aspect of the subject receives rather scanty attention In Part 2 the various groups of protozoa are considered, taking the reader to the beginning of the Sporozoa group The present volumes maintain the high standard set by the late Prof Doflein, and will be an indispensable part of any zoology library

Air Ministry Meteorological Office The Observatories' Year Book, 1926 comprising the Meteorological and Geophysical Results obtained from Autographic Records and Eye Observations at the Observatories at Lerwick, Aberdeen, Eskdalemuir, Cahirciveen (Valencia Observatory), and Richmond (Kew Observatory), and the Results of Soundings of the Upper Atmosphere by means of Registering Balloons (M O 304) Published by the Authority of the Meteorological Committee Pp 411 (London H M Stationery Office, 1928) 63s net

THE Observatories' Year Book for 1926 has followed that for 1925 at an interval of 9½ months, indicating progress towards the desirable goal of the issue of each year's observations during the following year The volume is enlarged by about forty pages by the inclusion, for the first time, of hourly magnetic data from Lerwick, the most northerly British observatory (60° 8′ N) In going from the Abinger magnetic observatory (the results for which are published in the Greenwich volumes) to Eskdalemuir, 4° to the north, there is a transition towards more disturbed conditions, but the increase of disturbance in going 5° farther north still, to Lerwick, is much greater The immense mass of meteorological and geophysical data recorded in these volumes with such convenient uniformity provides material not only for present researches, but will also almost certainly prove of use in ways yet unthought of to future generations

Orcharding By V R Gardner, F C Bradford and H D Hooker (McGraw Hill Publications in the Agricultural and Botanical Sciences) Pp xi + 311 (New York McGraw Hill Book Co, Inc, London McGraw Hill Publishing Co, Ltd, 1927) 15s net

THIS volume marks a definite attempt to fill the gap which exists between the practical considerations which govern the growing of fruit trees and the fundamental principles upon which such practice is founded Scientific explanations are suggested for many of the problems which beset the grower, as, for example, the biennial fruiting habit of the majority of apples Under questions of growth and nutrition, that of the carbohydrate supply of the tree is specially dealt with, as being of much importance in relation to the production and quality of the fruit

Quality is becoming of increasing importance with increasing competition, and in consequence greater attention is necessary to keep fruit trees free from insect and fungus pests, chiefly by means of various types of spray Appropriate marketing includes grading, attractive packing, careful transport with refrigeration if necessary, and the best choice of locality and salesmen, and due attention to all these details is essential for success and profit in fruit growing on a commercial scale

A B C of Adler's Psychology By Philippe Mairet Pp 116 (London Kegan Paul and Co, Ltd, 1928) 3s 6d net

AN excellent book Adler's individual psychology makes an appeal to those people who do not like to accept the more extreme views of Freud, Jung, or Stekel, but still feel the need of a practical psychology to explain many of the mal adaptations and neurotic features of the individual In this short summary, Mairet has made a very satisfactory presentation The author briefly traces the development of modern psychological ideas, and shows how Adler was led from his wide experience as a physician to build up his theory of inferiority and the individuals striving for superiority Throughout the book there is a sound emphasis on the importance of individual psychology to the social, religious, and educational aspects of the community

Man What? Whence? Whither? or, The Faith that is in Me By Capt R C T Evans Fourth edition Pp viii + 218 + 11 (Chatham Parrett and Neves, Ltd, 1928) 2s 6d

THOSE who like a book to deal with a wide range of topics will be well satisfied with Capt Evans's encyclopædic little volume It deals with free-will, conscience, suffering, reincarnation, prayer and miracle, the flood, psychical phenomena, sacraments, the Trinity, and so on The sincerity and earnestness of the writer are transparent, and as arousing reflection his work should prove valuable to many readers It is intended primarily for those who are troubled by the apparent antagonism between religion and science, ' in the hope that what comforted me may comfort them " The book is fertile in argument and contains much ingenious speculation J C H

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications*]

The Constitution of Nitrated Cellulose

IN a recent publication (*Zeit fur physikal Chem*, **130**, 616, 1927), Herzog and von Naray Szabó gave an account of the X ray examination of ramie fibre nitrated in various ways, and concluded that for any nitrocellulose containing from 4 41 to 13 31 per cent of nitrogen the diffraction spots on the 'fibre diagrams' were produced mainly by the substance cellulose trinitrate, two spots from unchanged cellulose occasionally persisting, and that all nitrocelluloses were therefore principally mixtures of cellulose trinitrate and cellulose

Two rather diffuse diagrams were given, one of which (for 12 99 per cent nitrogen) seems to show evidence of imperfect nitration In the later paper by von Naray Szabo and von Susich (*Zeit fur physikal Chem* **134**, 264, 1928), this diagram, with the unit cell proposed for cellulose, is withdrawn and replaced by a new diagram in which the layer lines are closer together, but the claim is still made that the nitrocellulose diagram is always compounded of those of cellulose and its trinitrate This theory is open to serious objections from many aspects of the chemistry and technology of nitrocellulose Many of these have been presented by Brunswig in two interesting articles (*Zeit fur ges Schiess und Sprengstoffwesen*, **23**, 337 and 384, 1928)

In an investigation which has been carried on in these laboratories for more than a year, a complete range of samples of nitroramie nitrated in widely different mixed acids, together with their denitration products, has been examined by X ray diffraction methods The fibre diagrams of the nitrates are frequently lacking in definition and are difficult to interpret, but whenever measurements have been possible they have been found to afford only the slightest basis for Herzog's theory

The nitration of cellulose in mixed acid is complicated by a loss of fibre structure which occurs with all mixed acids, for example, with those containing from about 30 per cent to 60 per cent of nitric acid, whenever the nitrogen content of the nitrocellulose reaches about 7 5 per cent It continues until 10 5 per cent of nitrogen is exceeded If the content of sulphuric acid is increased and the ratio H_2SO_4/H_2O has a certain value (about 1 7 to 1), the disintegration of the fibre structure may be greatly accentuated It is therefore convenient to consider three groups

The diagram of a nitroramie of less than 7 5 per cent of nitrogen shows the same spacings as that of its denitrated product but different relative intensities and is much weaker The spacings remain constant with increasing degree of nitration This type of diagram (*B*) may be contrasted with that of unaltered cellulose (*A*) It resembles that of fully mercerised cellulose, but excels it in sharpness and the intensities of the two are different The diffractions characteristic of the trinitrate do not appear, although from a mixture of unnitrated ramie with comparatively little of the highly nitrated fibre it is quite easy to produce them

In the second group (7 5 to 10 5 per cent) the nitrated material loses its fibre structure more or less, diffuse diffraction rings appear, but the denitrated product is still of type *B* and gives sharp lines

As to the third and technically important class, sharper diagrams of which have been produced by von Náray Szabó (loc cit) and by Andress (*Berichte*, **61**, 603, 1928), nitration in acids of technical composition nearly always results in diffuse spots, and the most important factor in securing definition seems to be a high content of nitric acid, say 50 per cent of the nitration mixture In the cases of both cotton and ramie, as the nitrogen content falls to about 11 per cent, certain spots from planes parallel to the fibre axis are altered in spacing through small ranges in which confusion with diffractions of remanent cellulose of either type is not possible In some instances the diagrams show an equatorial spot which falls in the same position as the 4 4 spot of cellulose, but its intensity is quite disproportionate to the possible cellulose content and its position changes on denitration The denitration product from highly nitrated ramie is practically indistinguishable from that of pure cellulose (type *A*), but as the nitrogen content decreases to about 12 per cent, type *A* passes into type *B* more or less gradually, according to other conditions holding in the nitration

It appears therefore that by the action of the mixed acid the cellulose residue is converted into type *B* for all but the highest degrees of nitration, and that the lines obtained in the range 10 12 per cent of nitrogen do not coincide with those given by the trinitrate or by cellulose of either type Even if spots of type *B* were present it would not be certain, in view of the diffractions given by the less nitrated products, that they originated from unnitrated cellulose

To account for these facts in a systematic way further data will be required, and it will probably be of great use to determine accurately the densities of certain nitrocelluloses and their denitration products and so obtain some indication of the closeness with which their structures are packed

F D MILES
J CRAIK

Nobel Research Laboratories,
Ardeer, Jan 7

The Distribution in Space of the Sunlit Aurora Rays

SOME time ago (NATURE, Sept 3, 1927) I discussed the position of the sunlit aurora rays with my colleague, Prof Krogness, and he made the suggestion that the great heights of these rays might perhaps be explained by assuming that the sun's radiation pressure pushes away the upper atmosphere like a small tail of a comet, and if the corpuscular rays hit this tail they produce aurora at unusual heights

As this idea seemed very promising, I again took up the calculations of the aurora rays in the period from 1911 to 1922, mentioned in my letter to NATURE of Sept 3, 1927 The only two occasions when sunlit aurora rays were photographed simultaneously from two stations in order to obtain their altitude were during the nights of Mar 22-23, 1920, and May 13-14, 1921

In Fig 1 we see the position of all the rays from these two nights compared with the position of the earth's shadow The figure represents a vertical section of the earth, and the tangent to the earth's surface is the boundary between the sunlit and dark atmosphere For each point of an aurora ray the position in the vertical plane through the centre of the earth and the sun is marked by a small circle for aurora of Mar 22–23, and by a black dot for aurora of May 13–14 On each aurora ray two points are calculated and combined with a straight line representing the ray This line is continued beyond the points as far as the photographs indicate If the ray passes out of the photographic field it is marked by an arrow, and if the foot or summit can be seen on the photograph no arrow is given Some rays form a

rather large angle with the vertical, but this is only due to observation errors on account of a small parallax

The figure gives a very suggestive idea of the action of the sunlight, the following conclusions seem to be well founded

1 The action is not a direct one, because the rays situated nearer the sunset point O are lower than those farther away

2 The action of the sunlight seems to be a pressure on the upper atmosphere, driving it away tangentially to the earth, like a tail

3 When the corpuscular rays hit this tail they produce aurora rays the height of which increases with their distance from the sunset point

4 The sunlit aurora rays situated in this tail seem to be confined to it, and do not descend beyond the frontier line between sunlit and dark atmosphere

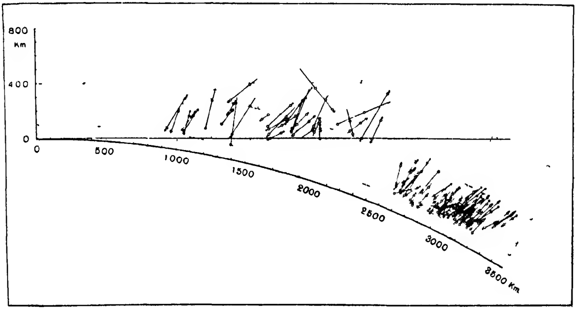

FIG 1

In the space between the tail and the earth up to distances of 2500 km from the sunset point, no aurora rays are seen

5 From 2500 km and farther reckoning from the sunset point, the action of the tail seems to have ceased, so that aurora rays here occur with the usual night altitude from 100 to 400 km

From 1922 to now a large amount of material of more than 500 photograms of auroræ from southern Norway has been collected, and amongst this are many photograms of sunlit aurora rays It will be very interesting to see if the measurement and calculation of these rays confirms the above mentioned conclusions or not

A still more interesting problem for solution will be to obtain the spectrum of these sunlit aurora rays

CARL STØRMER

Bygdö, near Oslo, Dec 16

The Understanding of Relativity

THE leading article in NATURE of Nov 3, 1928, by H D, on this subject, contains views so unusual as apparently to deserve some notice I have waited some time for more competent authorities to express themselves regarding these views, but as no such expression has yet been seen by me, a few brief thoughts are offered here in lieu thereof

H D refers to the difficulty of explaining the theory of relativity The attempts to do so, he says, "represent the most conspicuous failure of modern scientific exposition" He says further "The real difficulty that besets the beginner in the subject is, not to *understand* what he is told, but to *believe* it," and that, to escape this difficulty, "Salvation must be by faith and not by reason" It does seem regrettable, to say the least, that men of science should have to resort to the rôle of the 'hot gospeller,' which rarely, if indeed ever before has been the method of scientific investigation

Let me refer to just one point in the theory of relativity On p 16 of Einstein's 'Relativity, the Special and the General Theory" (3rd ed, Methuen and Co, London, 1920), a man in a moving railway carriage is supposed to walk in the carriage in the same direction in which the carriage is moving, What would be the velocity of the man with respect to the railway embankment? This velocity, as everybody knows, would be the sum of the man's walking velocity added to the velocity of the carriage But according to Einstein, this result "canot be maintained" On p 18 Einstein modifies the illustration, taking the earth for the railway carriage and a ray of light for the man, both moving in the same direction in which case, according to classical mechanics, the resultant velocity of the light with respect to the earth would of course, be the difference of the two velocities But not so according to Einstein's theory The velocity of the light is not at all affected by the velocity of the earth In other words, either the sum or the difference of these two velocities is always equal to one of the velocities alone This certainly appears to call for H D's appeal to faith, for the slightest grain of common sense would never permit us to believe that $V+v=V$, or $V-v=V$, when each velocity has a real value

It is true that Einstein endeavours to justify his views in this case by the results of the experiments of Michelson and Morley, which clearly show that the velocity of light upon the earth is always the same in all directions, whether parallel to the earth's orbital motion or at right angles to it But is it not far more rational to account for this fact by supposing

the earth to have an ethereal atmosphere of its own by means of which the light is transmitted on the earth's surface and which is always carried with the earth in its orbital motion and also in its daily rotation near the earth's surface? We certainly do not know that such an atmosphere does not exist, and it certainly would account for the facts perfectly, without the violation of a single principle of mechanics

Now the negative result of Michelson and Morley's experiments, in the supposed absence of this local atmosphere, constitutes the corner stone of Einstein's theory of relativity (see NATURE, **111**, 240, and **117**, 6), and the effect of this paradoxical foundation upon even the highest intellects is illustrated by the following quotation from Sir Oliver Lodge "The relative velocity of the light and the observer (travelling with speed u to meet it) must be $c+u$—common sense forbids otherwise,—but if he seeks to measure it he will get, we are told and inclined to believe, not $c+u$, but simply c" (NATURE, **107**, 748) In other words, a great scientist admits that he is inclined to believe what he admits common sense clearly forbids him to believe Must we, then, subscribe to such renunciation of our reasoning faculties and to H D's appeal to blind faith before we can enter the portals of Einstein relativity?

EVAN MCLENNAN

Corvallis, Oregon, U S A
Dec 7

MR MCLENNAN's suggestion, as has often been pointed out, is inconsistent with the observed phenomena of the aberration of light

His letter seems to imply that, if it is rejected, we must subscribe to "renunciation of our reasoning faculties and to H D's appeal to blind faith before we can enter the portals of Einstein relativity" H D, however, did not appeal to "blind faith," nor does he subscribe to "renunciation of our reasoning faculties" In order to grant full assent to a deduction from experiment, one must first understand the reasoning leading to the deduction, and secondly have faith that reasoning on such foundations will not mislead The failure of many people to give full assent to relativity is generally believed to be associated with the first factor the article in question contended that it is actually associated with the second The difficulty—at any rate in the special theory which contains the paradoxes mainly responsible for the theory's bad reputation—is, not to understand a fairly simple argument but to trust the understanding to lead to the truth when deep rooted prejudice points in the opposite direction H D

Dec 29

The Diffraction of X-rays in Liquids containing Heavy Atoms

IT is now generally accepted [1,2,3,4] that X ray diffraction in liquids is mainly due to the relative positions of the molecules and only in second instance to their inner structure If the effect of the last factor is known, some information regarding the first factor may be obtained from an analysis of the observed diffraction pattern [3] This circumstance is realised in the case of monatomic molecules, for example, argon, or mercury [5,6] In most cases, however, as when using organic compounds, the inner structure is not known, and then no unequivocal conclusion, or nearly none, may be drawn from the diffraction pattern

The use of an especial X ray spectrograph [6] constructed by Prof Coster and myself for the investigation of heavy (that is, absorbing) liquids has opened up a new line of attack The guiding principle is to introduce very heavy atoms into the liquid and to get definite evidence concerning their mutual arrangement by their diffraction pattern This diffraction pattern will depend almost entirely on the relative positions of the heavy atoms, as in comparison to their scattering power that of the other atoms may be neglected, the scattering power being roughly proportional to the square of the atomic number under the conditions of the experiment (scattering angles of 1° to 15° using Cu or Fe K radiation)

A first application was made on the diffraction of X rays in a solution [7] of iodine ions in water and of carbon tetrachloride and methylene iodide in benzene If the current view is accepted that the dissolved molecules in these cases are dispersed like the molecules in the gaseous state, then the theory [1,3] predicts a characteristic difference between the diffraction pattern of these solutions and that of ordinary liquids This difference is chiefly found in the amount of scattering at small angles, which should be small in ordinary liquids and considerable in gases, and consequently also with our solutions I was able to get experimental evidence of this effect when dilute solutions (about 1 molecule dissolved in 15 solvent) are used

A curious peculiarity, however, was found with iodine ions (potassium and lithium iodides were used) when the concentration was increased (up to 1 molecule dissolved in 3 solvent) In this case I observed a reversal of the effect, the scattering at small angles diminishing again in a marked manner with increasing concentration This phenomenon is not to be explained as due to a geometrical close packing of the iodine ions, for a simple calculation [3] shows that this influence is much too small The effect is, however, readily explained as due to the electrostatic repulsion of the iodine ions Indeed, this will tend to keep them apart, as if the ions were much bigger, causing in this way an apparent close packing With lithium iodide this effect seems to be visible at smaller concentrations than with potassium iodide

Another application of the same method has been made in studying organic compounds, especially those with long CH_2 chain (C_6 dibromide, C_{12} dibromide [8] and C_{16} mono iodide were used) In this way evidence of their arrangement is obtained in a less ambiguous manner than usually

Perhaps it is useful to add that with fatty acids, also studied, the results of Stewart and others [9] were confirmed and extended to C_{13}-, C_{14}-, and C_{16}-acids A full account is to appear in *Zeitschr f Phys*

My thanks are due to Prof Coster for his helpful criticism

J A PRINS

Natuurkundig Laboratorium
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Groningen

[1] C V Raman and K R. Ramanathan, *Proc Ind Assoc for Cultiv Science*, 8, II, 127, 1923

[2] P Debye, *Jour of Math. and Phys Massachusetts*, 4 133, 1925, and *Phys Zeitschrift*, 28, 135, 1927

[3] F Zernike und J A Prins, *Zeitschr f Phys*, 41, 184, 1927

[4] W H Keesom and J de Smedt *Proc Amsterdam*, 25, 118, 1922 W H Keesom, *Proc. Amsterdam*, 30, 341, 1927

[5] J A Prins *Physica* 6 315, 1926

[6] D Coster et J A Prins *Jour de Phys* 9 153, 1928

[7] Solutions have been studied from another point of view by R W G Wyckoff ("The Structure of Crystals," New York, 383, 1924) and W H Keesom (*Proc Amsterdam*, 30 341, 1927)

[8] Kindly put at our disposition by Prof L Ruzicka in Utrecht.

[9] G W Stewart and others, Several articles *Phys Rev* 31, 32, 1927 and 1928 J R Katz, *Chemiker Ztg* 51, 384 1927

Population Problems

THE article by A M C S in NATURE of Dec 29 shows convincingly how urgent are the population problems confronting the British community, and how inadequate is the knowledge at present at our disposal to solve them These problems are by no means exclusively British, and they are much more acutely realised in many countries than here It is therefore appropriate that, with the Editor's permission, I should remind readers of NATURE that an organisation has recently been established to deal with precisely such questions as are raised in the article, namely, the "International Union for the Scientific Investigation of Population Problems," with its constituent bodies, the national committees which are now being set up in each of the countries represented in the Union

I cannot ask for space to describe the plans for developing research, both internationally and within the various national units, from which the founders of the Union, men eminent in many branches of science in many countries, confidently expect a great advance in the elucidation of population problems, and I must confine myself to the question of the financial provision on which the success of their efforts will depend

Sufficient resources are already in great part assured to the International Union itself, and to certain of the national committees, notably those of the United States and Italy , but they are at present almost non existent in the case of the British section It will not do for Great Britain, with her vast and varied responsibility for human populations, to fall behind in this enterprise, and it is with the object of trying to enlist support for the British National Committee which has been formed under the title of the "British Population Society" in connexion with the Union that I am asking the Editor to publish this appeal

The only way in which we can hope to raise the very moderate income required for current expenditure is by way of subscriptions both from institutions and from individuals, which we propose to fix at a minimum of £1 per annum, giving the right to attend meetings, receive publications, etc The primary object of the Society is to focus and co ordinate research, and we are therefore specially anxious that all institutions of scientific or sociological character, universities, and other learned bodies interested in one or other branch of the population question, should join the new Society We are encouraged to hope that they may do so by the fact that two or three important institutions of this character have already consented to be represented on the council and to support our work by quite substantial subscriptions, but we should hope that individuals interested or qualified in any particular branch of population research may also be induced to join us I need scarcely add that if we are to take a worthy share in assisting and promoting research, both by the Union and at home, much more will be needed, but for this we shall have to look in the future to the generosity of donors inspired by a conviction of the great importance of this work to the welfare of human population

The original members of the council, which will be added to as time goes on, are Sir William Beveridge, Sir Charles Close, Sir Arthur Keith, Sir Humphry Rolleston, the Dean of St Paul's, Mr Maynard Keynes, Capt Pitt Rivers, Dr R A Fisher, Dr David Heron, Mr M Pease, and Profs A M Bowley, F A E Crew, A M Carr Saunders, B Malinowski, J S Huxley, and J W Gregory

May I add that I shall be glad to answer any inquiries on the subject either of the International Union or the British Society, and that communications may be addressed either to me as chairman of the council, or the honorary secretary, Mr Eldon Moore, c/o The Eugenics Society, 20 Grosvenor Gardens, London, S W 1

BERNARD MALLET
8 Eccleston Square, S W 1

Magnetic Properties in Relation to Chemical Constitution

THROUGH the kindness of Dr Kapitza and Dr Webster, we have had the opportunity of examining in the Cambridge Magnetic Laboratory a number of compounds to which formulæ with single electron bonds have been assigned These compounds are of two principal types (1) *Pervalent salts*, including PCl_5, $SbCl_5$, $SbMe_3Cl_2$, $SbMe_3Br_2$, $SbMe_3I_2$, the α and β forms of $TeMe_2Cl_2$, $TeMe_2Br_2$ and $TeEt_2I_2$, α $TeMe_2I_2$ and α $TeMe_2I_4$, and a number of analogous compounds such as PCl_3, $POCl_3$, $AlCl_3$, TlI_3, BiI_3, CsI_3 (2) *Co ordination compounds* including the Li , Be , Al , Co , Ni , and Fe derivatives of benzoylcamphor Except in the case of substances containing a metal of the transition series, these compounds have all proved to be diamagnetic We therefore conclude that all the electrons are magnetically paired, just as they are in compounds in which the valency electrons are present as pairs of shared electrons or as 'lone pairs' of unshared electrons The numerical results of these experiments will be published later

We have also examined some cuprous and mercurous salts for which no magnetic data appear to have been given previously We find that mercurous chloride and cuprous iodide are both diamagnetic, whereas mercuric chloride is diamagnetic and cupric chloride is strongly paramagnetic The diamagnetism of mercurous chloride can be accounted for readily, since physico chemical measurements with dissolved mercurous salts point to the existence of a diatomic ion derived from bivalent mercury, for example, $Hg_2(NO_3)_2 \rightleftharpoons Hg_2^{++} + 2NO_3$ Moreover, X ray analysis of crystals of calomel has disclosed the existence of chain molecules containing bivalent mercury, as shown by the formula Cl Hg Hg Cl The metallic atoms in the mercurous salts therefore contain completed shells of 18 unshared *O* electrons, with an outer shell of 2 or 4 shared electrons, and are diamagnetic like the free metal On the other hand, the copper atoms in a bivalent cuprous salt would contain an incomplete shell of 17 unshared *M* electrons, with an outer shell of 2 or 4 shared electrons, and would therefore be paramagnetic like the cupric salts

The fact that cuprous iodide is diamagnetic, shows that the cuprous salts, unlike the mercurous salts, contain only univalent ions or atoms of the metal This result also is in agreement with X ray analysis, which has shown that the structure of cuprous iodide is similar to that of silver iodide, $\overset{+}{Ag}\overset{-}{I}$ Conversely, however, the fact that cupric sulphide, CuS, is diamagnetic like cuprous sulphide, Cu_2S, suggests that it may really be a cuprous disulphide $\overset{+}{Cu}\ S\ \overset{-}{S}\ \overset{+}{Cu}$, just as iron pyrites has been shown by X ray analysis to be a ferrous disulphide, $\overset{++}{Fe}\ S\ S$ This conclusion can be justified by comparison with the polysulphides of the formula Cu_2S_x, but it is also confirmed by X ray analysis, which shows that the crystal structure of cupric sulphide is different from, and more complex than, that of all other binary monosulphides

T M LOWRY
F L GILBERT
University Chemical Laboratory,
Cambridge

A New Method of Recording Ciliary Movement

THE rate of vibration of cilia is usually too great to permit of accurate observation with an ordinary microscope unless the light be interrupted at a suitable frequency and for suitable periods of time If the frequency of vibration be approximately fourteen or more beats per second, the form of each cilium during the two phases of its beat and the nature of the metachronal waves which pass over the epithelium, can be readily observed by means of a suitable stroboscope If, however, the frequency of vibration is lower than ten per second, accurate observations of this type are impossible owing to the low intensity of illumination which is necessary to reduce 'flicker' to a convenient level In such cases permanent records of individual

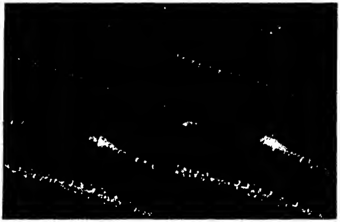

FIG 1 —Two successive photographs of the metachronal waves passing over a ciliated epithelium The cilia are seen in side view with their beat at right angles to the plane of the paper Each wave has two components (i) The dark finger like processes representing cilia in the effective phase of their beat (ii) Semicircular waves outlined by an illuminated edge representing cilia in the recovery phase of their beat The waves are travelling from right to left

cilia or of the metachronal waves can be made by synchronising, with a variable speed stroboscope, the shutter of an ordinary cinematograph camera, in this way 'slow motion' records of rapidly vibrating cilia can be obtained, and the frequency and velocity of beat can be determined with accuracy

The lateral cilia on the gills of *Mytilus edulis* have been examined by these methods The frequency of vibration of individual cilia varies, in different samples of tissue, from 5 to 16 vibrations per second at 22° C, whilst the metachronal waves move over the epithelium with an average velocity of 100 μ per second The wave-length of the wave varies with the frequency of its constituent cilia, and the form of the wave may vary from time to time at any given point without interfering with the continuity of the whole wave system

So far as is known, this constitutes the first successful attempt to establish a permanent record of ciliary activity With the data thus available it is possible to analyse ciliary movement with accuracy, and we are no longer restricted to observations of the velocity at which particles move over the epithelium or to the behaviour of relatively inactive cilia

It is interesting to note that the new methods illustrate very clearly the difference in the form of a cilium during the two phases of its beat, and that the nature and propagation of a metachronal wave is closely associated with the individual properties of the constituent cilia and do not appear to be the result of an extraneous timing mechanism J GRAY

Zoological Dept, Columbia University,
New York City

Horsetail Choking Field Drains

FIELD drains are commonly blocked by the roots of trees growing in their vicinity Sycamore, ash elm, and naturally willow, are offenders in this respect, oak and beech rarely cause such trouble, at any rate in my experience To find such mischief resulting from the rhizomes (underground stems) of the horsetail (*Equisetum*) was a revelation to me

A wet patch developed recently in a pasture field here The drains have just been examined and found to be stopped up in places by the matted rhizomes of *Equisetum*, presumably the common species, *E arvense* My man reported the matter to me, and said the stuff he had pulled out of the drain pipes could not be tree roots, as there were no trees near, and besides the strands were soft and easily broken He thought they might be the roots of 'sieves' — the local name for rushes (*Juncus communis*)—these weeds being now in evidence on the wet area I greatly doubted this, and on investigation found the strands to be the underground stems of the horsetail Hitherto I was unaware that *Equisetum* grew in this field, but my man informs me that it was quite noticeable when the ground was last ploughed towards the end of the War, and evidently it still persists to some extent

The rhizomes have great penetrating power, for they were found in the pipes at a depth of three and a half feet In the cuttings made down to the drainage level, the rhizomes can be seen running here and there in the subsoil, but in no great abundance In the pipes, however, they increase greatly, giving off at each node a number of roots which branch copiously, effectually blocking the drain The rhizome is about the thickness of a straw and the root much finer They are both almost black in colour

Farmers in this district are well acquainted with the plant, knowing it by the name of 'paddock pipes' It has an evil reputation of scouring cattle

JOHN PARKIN

Blaithwaite,
Wigton, Cumberland,
Dec 11

Band Spectrum of Chlorine or Hydrogen Chloride

IN the *Zeitschrift für Physik* for August, Kondratjew and Leipunsky describe the emission spectrum of chlorine heated in a silica tube to about 1000° C I compared their photograph with one taken by W West and myself in 1924 of the flame of chlorine burning in hydrogen, which shows a continuous spectrum with a maximum at 480 $\mu\mu$ I could find no record of the brand of plate used, so asked two honours students, Messrs Reid and Soutar, to obtain a new photograph and compare it with the one obtained by simply heating chlorine To my surprise a beautifully clear band spectrum was obtained

The only difference in method I can recollect was that a silica jet was used for the chlorine instead of the platinum jet used in 1924 The continuous light is visible enough using a direct vision spectroscope, but is apparently of much less actinic intensity than the band spectrum in the apparatus now used The flame is started by a spark from platinum wires connected to a small induction coil, if the sparks are maintained while the photograph is being taken, the continuous emission spectrum at 260 $\mu\mu$ is obtained as

well (Fig 1), ascribed by Oldenberg (rather doubtfully) to the union of Cl^+ and Cl^- The arrows indicate the approximate positions of the middle band of the new spectrum about 385 $\mu\mu$, about a dozen of these bands can be made out on the photographs, the interval being about 10 $\mu\mu$, they fade off in intensity about equally on either side of the brightest band, but on the ultra violet side they begin to exhibit a structure, which, however, cannot be studied with the low dispersion at our disposal

The new spectrum appears to resemble somewhat, but not to be identical with, one described by L and E

FIG 1

Bloch (*Comptes rendus*, **184**, 744 1927) obtained by passing an oscillatory electrodeless discharge through a tube containing sodium chloride

The explanation first considered was that the heat of the flame produces chlorine atoms inside the zone of combustion and hydrogen atoms outside The union of these atoms produces sufficient energy to give rise to radiation in the ultra violet region, and if this is absorbed by the chlorine molecule might give rise to a resonance spectrum But the bands are produced in the outer zone of the flame, which points to the molecule of hydrogen chloride as the emitter The fine structure is being examined with the help of Prof Curtis of Newcastle

E B LUDLAM

University Chemical Laboratory,
Edinburgh

Changes in Nitrocellulose when Exposed to Light

LORD RAYLEIGH mentions (NATURE, Oct 27) that celluloid containing malachite green changes to a red colour when exposed to sunlight He rightly remarks that this change is caused by the nitrocellulose and not by the camphor present in the celluloid Berthelot and Gaudechon (*C R* 153, p 1220, 1911) found that oxides of nitrogen are liberated when nitrocellulose is exposed to ultra violet light It has also been known for some time that 'solarised' nitrocellulose becomes acid

The production of the deep red colour is apparently due to the nitrogen oxides liberated, since it can be shown that malachite green (= Victoria green) acquires a deep red coloration with nitrous acid Nitric acid produces a greenish yellow colour in dilute solutions Both colours fade on standing

It may be of interest to mention that the wave length most effective (per quantum absorbed) in causing acid decomposition of nitrocellulose is about $\lambda = 3100$ A, and does *not* correspond to the greatest absorption power of nitrocellulose A more detailed account of the photochemical decomposition of nitrocellulose was given in a recent paper by DeVore, Pfund, and Cofman at the last meeting of the American Chemical Society, and will be published in the near future

V COFMAN
H. B DEVORE

E I Du Pont de Nemours and Company,
Experimental Station, Wilmington, Del,
Dec 5

The Average Life Period of an Atom

THE unwary reader of Dr J H J Poole's letter (NATURE, Dec 22, 1928, p 960) would not gather that I had suggested any explanation of the heat conducted out of the earth that is not of radioactive origin On the theory I have given at various times it is original heat, a relic of the earth's primitive fluid state When Dr Poole says, "We can only attribute the remaining 13 per cent to the apparently stable elements," he indicates that he has not read the theory that he appears to be quoting Allowance for heat due to other sub atomic changes would decrease the amount due to radioactivity more than that due to original heat

Dr Poole also says that "it is only by assuming a rather arbitrary distribution of radioactivity with depth that we can ensure that the earth as a whole is cooling" The upward concentration of radioactive matter is not assumed in order to ensure that the earth as a whole is cooling, but in order to co ordinate the facts of the temperature gradient in the earth's crust, the radioactivity of surface rocks, and the law of heat conduction When this is done, the cooling of the earth follows as a consequence it is not a hypothesis The alternative hypothesis mentioned by Dr Poole begins by rejecting the law of heat conduction

HAROLD JEFFREYS

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Ultra-Violet Raman Spectrum of Water

So far, the study of the Raman effect has been confined to the visible region of the spectrum only By the use of an all quartz apparatus similar to that of glass used by Prof Wood (*Phil Mag*, Oct 1928), I was able to obtain the effect in the ultra violet region for water in two hours Fig 1 shows that for every bright line in the mercury arc spectrum, there is a

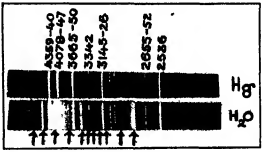

FIG 1

Raman band in the spectrum of the light scattered by water There are altogether eleven bands clearly noticeable in the spectrum, which are marked with arrows Measurements of the wave lengths of these Raman bands have shown that water has an absorption band at 2.97 ± 0.05 μ, in close agreement with the values ranging from 2.95 μ to 3.06 μ from previous infra red absorption measurements

I RAMAKRISHNA RAO

Wheatstone Laboratory,
King's College,
Dec 10

Repetition of the Michelson-Morley Experiment

By Prof A A MICHELSON, For Mem R S (Research Associate, Carnegie Institution), Dr F G PEASE, and F PEARSON

THIS investigation was undertaken with the view of making a more accurate test than had hitherto been obtained, and may be divided into three parts as follows

The first preliminary observations were begun in June 1926 The principle employed was not essentially different from that in the original Michelson Morley experiment, with the exception that in this investigation the observer was mounted on the apparatus, revolving with it while making observations

Several hundred observations were made, all stationary interferometer fringes could therefore be measured in the usual way by means of a micrometer eye piece, the observer being at rest above the centre of the rotating disc The length of the light path in this experiment was fifty three feet

In consequence of inadequate temperature provision (and probably unsymmetrical strains in the apparatus) the results, while not so consistent as could be desired, still show clearly that no displacement of the order anticipated was obtained

In the final series of experiments, the apparatus

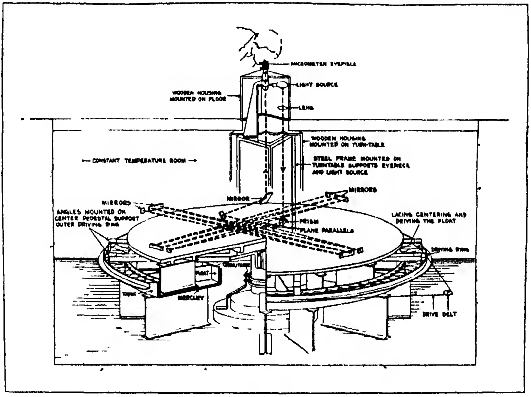

FIG 1

indicating the same negative result as was obtained in the original investigation According to calculations furnished by Dr Strömberg, a displacement of 0·017 of the distance between fringes should have been observed at the proper sidereal times No displacement of this order was observed

The second preliminary investigation was begun in the autumn of 1927 In this, the optical parts were supported on a heavy disc of cast iron, floating on a circular mercury trough as in the original experiments The chief modification, however, consisted in the fact that the light source was placed vertically over the centre of the revolving disc and rotated with it The return image, by a simple system of reflections, was rendered stationary, thus avoiding the necessity of mounting the observer on the apparatus The was transferred to a well sheltered basement room of the Mount Wilson Laboratory The length of the light path was increased to eighty five feet, and the results showed that the precautions taken to eliminate effects of temperature and flexure disturbances were effective The results gave no displacement as great as one fifteenth of that to be expected on the supposition of an effect due to a motion of the solar system of three hundred kilometres per second

These results are differences between the displacements observed at maximum and minimum at sidereal times, the directions corresponding to Dr Strömberg's calculations of the supposed velocity of the solar system A supplementary series of observations made in directions half-way between gave similar results

Progress of the Great Barrier Reef Expedition

By Dr. C. M. YONGE, Balfour Student, University of Cambridge

AFTER four months at its headquarters on Low Island, forty miles north north-east of Cairns, North Queensland, the expedition is now (Nov 21) well advanced with its extensive programme of research Excellent living accommodation, and what is in effect a well equipped marine laboratory, have been erected and fully established The island has been well chosen as the site of work Situated midway between the Barrier and the main land, here only fourteen miles apart, it possesses a fauna characteristic of both these regions, there is a mangrove swamp with the usual associated fauna and flora, while, exposed on the reef flat at low tides and all around the island beneath low water, there is an abundant growth of corals comprising many genera There is thus ample material for experimental and observational work, while the island is so small—although thoroughly characteristic of the inner islands or 'cays' which are numerous in the northern portions of the Barrier—that a very detailed ecological survey is possible The ecological work has been greatly helped by the preparation of a mosaic of the island from a complete series of aerial photographs taken at a height of 2000 feet over the island and reef by an amphibian flying boat belonging to the Royal Australian Air Force The services of this machine were kindly provided by the Ministry of Defence

Plankton and hydrographic stations have been taken weekly within the Barrier, at a position three miles east of the island This work, under the entire charge of Mr F S Russell, who is assisted in his work on zooplankton by Mr J S Colman, is carried out in the *Luana*, a ketch rigged yacht with a powerful motor, the property of Mr A C Wishart of Brisbane, who is personally in charge of her and is assisted by Mr C Vidgen, also of Brisbane Half-hour oblique hauls are made with the stramin and the coarse and fine silk tow nets, while vertical hauls are made with the Nansen net Two similar stations have been taken outside the Barrier, but work there is dependent on the weather, on one occasion a powerful motor launch was hired from Cairns and deep ocean water (150 400 fathoms) was visited Weekly plankton samples are also taken over the Low Island Reef A series of hauls, taken in daylight to study the vertical distribution of the zooplankton, showed that, while the surface layers were avoided by most species, there was already a marked increase at 9 metres, the total number of animals rising from 2035 at the surface to 67,822 at 11 metres A station has also been taken at night to study diurnal changes in distribution

FIG 1—View of Low Island from south taken at low tide Four huts belonging to expedition are seen immediately behind the beach

To date, there have been fluctuations in the zooplankton, but no great changes such as are experienced in temperate waters It must be remembered, however, that seasons here are far less marked Similar work on phytoplankton has been carried out by Miss S M Marshall, samples of sea water being taken at various depths by means of the water bottle, while vertical hauls with the Apstein net have been taken to compare with work elsewhere Here, again, the results so far show no startling variations, and the numbers, as compared with British waters, are low The reason for this paucity in the phytoplankton is revealed by the results of the chemical and hydrographic work carried out by Mr A P Orr Nutrient salts have been consistently low at all depths, although pH value and oxygen saturation have shown a slight rise throughout since the work was commenced There has also been a gradual rise in temperature and salinity Outside the Barrier similar results have been found for the upper layers, but instead of mixing taking place throughout as in the inner station (32 metres), there is a well marked discontinuity layer between 50 and 100 metres over the 100 fathom line Temperature, pH value, and oxygen saturation all show a marked fall below 50 metres, but nutrient salts are present in appreciable amounts Farther out, in deeper water, about 400 fathoms, this was still more marked, at 500 metres the phosphate content being 42 mgm per cubic metre as compared with between 5 mgm and 10 mgm above 50 metres

A series of samples taken at frequent intervals over a twenty four hour period from over the reef flat, where there is much living coral, have yielded results of great interest As soon as the tide leaves the flat at night, there is a rapid fall in pH value and in oxygen saturation, the latter dropping so low as 25 per cent Open sea conditions are quickly restored when the tide returns During the day, both pH value and oxygen saturation rise considerably in the pools left by the tide, open

sea conditions again prevailing after the tide has risen. When left by the tide, the temperature of the coral pools rises considerably by day and falls by night, the salinity rising slightly by night and more by day At a depth of two fathoms in the lagoon among rich coral, the tide has little effect, and the changes are related to light and darkness chiefly

The work of the reef party under Dr Stephenson has been varied He has spent the majority of the first three months in the preparation of an elaborate experiment on the growth rate of corals One hundred square blocks of concrete have been made, and to each has been fixed one or more living corals of many different genera The blocks, after being photographed with the corals *in situ* by means of an apparatus which ensures that they can be photographed later at exactly the same angle and distance, have been spiked down firmly in two specially chosen areas To test the effect of different environments on growth, ten further blocks have been provided with the halves of divided colonies and the halves planted out in different habitats Dr Stephenson has examined at regular intervals the gonads of the corals *Favia*, *Symphyllia*, and *Lobophyllia* All are hermaphrodite, and at present have well developed ova and less developed testes Weekly gonad samples of eight common reef animals, and examinations of the spawn and breeding habits of reef animals, have been made by Mrs Stephenson It is interesting to record that the common chiton (*Acanthozostera gemmata*) has twice spawned on the night of full moon Mr F W Moorhouse, of the University of Queensland, has assisted Dr Stephenson, and has also carried out intensive work on two species of oyster, two of bêche-de-mer, and on the commercial *Trochus* (*Trochus niloticus*) He is making regular gonad samples of all, while the last named is being farmed for observations on the growth rate, which is remarkably rapid He is also working on a commercial sponge of fair quality common on this and neighbouring reefs

FIG 2—Outside of laboratory on Low Island.

Mr G Tandy, the botanist, has collaborated with the other members of the reef party in the general ecological survey now being carried out, and has also done extensive collecting of marine algæ He has studied in the greatest detail possible the conditions of plant life on the Low Island Reef, illustrating this with as complete a series of photographs as possible He has also collected some data on the rate of growth of algæ There is no *Lithothamnion* reef here or in the neighbourhood, but the ubiquity of encrusting corallines is extraordinary, especially on the lower branches of the common staghorn coral

While the time of the leader of the expedition has been chiefly occupied with details of administration and matters concerning its efficient running, a good beginning has been made on the intensive study of the feeding mechanisms of corals The extent to which even corals with the least developed polyps can capture actively swimming planktonic organisms of frequently relatively enormous size is remarkable, while the reversal of the direction of ciliary beat appears to be undoubtedly of common occurrence in corals Symbiotic algæ in vast numbers have been found in every individual of every genus examined It is hoped to extend our knowledge of the function of these in the metabolism of the corals They certainly produce an abundant supply of oxygen , elaborate experiments in which cleaned coral colonies in sealed glass jars have been placed in the sea for periods of nine hours, first in the light and then in the dark, have shown that, whereas in the light the oxygen content of the water may increase by so much as 100 per cent, in the darkness it may decrease almost to zero The phosphate content decreases to zero usually under both conditions, protein metabolism not being dependent on light The oxygen and phosphate determinations have been carried out with great accuracy by Mrs Yonge

The extent to which the corals with their symbiotic algæ form a closed cycle is revealed by the fact that corals have been kept in sealed glass jars for fourteen days in the sea and have not only lived but the water in some of the jars also contained a higher percentage of oxygen than at the beginning of the experiment Investigations are proceeding into the part played by the algæ which crowd the exposed mantle surface of the giant clams *Tridacna* and *Hippopus* in the metabolism of these animals

The effect of starvation and deprivation of light upon the corals and their contained algæ is being studied in the small aquarium attached to the laboratory, a special apparatus having been constructed for this purpose Investigations of the digestive enzymes of corals show that corals are

(*Continued on p 99*)

Supplement to NATURE

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The Transition from Live to Dead the Nature of Filtrable Viruses [1]

By Prof A E BOYCOTT, F R S,
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RUTHERFORD was an example of the danger and folly of cultivating thoughts and reading books to which he was not equal It is all very well that remarkable persons should occupy themselves with exalted subjects which are out of the ordinary road, but we who are not remarkable make a very great mistake if we have anything to do with them —W HALE WHITE, preface to the second edition of "The Autobiography of Mark Rutherford"

I do not propose to enter at length on the old controversy between vitalism and mechanism Pathologists might with advantage have taken a greater share in it than they have, for it would take a hardened mechanician to maintain his faith in face of our daily experience of repair adaptation and all the other purposive compensations for injury of which the body is so abundantly capable Unfortunately, our facts have not been widely known to those who have felt inclined to discuss the question So far as I can see, the attempt to 'explain life by chemistry and physics' has completely failed It was thought at one time that if only the microscope could be made to magnify enough, we should see life going on Hope was then transferred to biochemistry, which has done just what the microscope did—it has helped us enormously to understand the mechanisms of live things and not at all to explain life But if vitalism has had the best of the argument, it has not led to a very profitable or a very satisfactory position Vitalism is often mysticism, and (which is why mechanism has been so popular) any dualistic interpretation of the world is always repugnant to natural human instincts

It is possible to escape dualism in another way, and I suggest that the vitalistic controversy in any thing like the form it has taken during the last forty years is out-of-date, that instead of emphasising the differences between live and dead things we should make as much as we can of their similarities, and that instead of dividing the world into two distinct categories we should regard it as being made up of one series of units with properties which differ more in degree than in kind This is not the mechanistic view, for we come to it, not by explaining live things by dead things, but by realising that the characteristics of live organisms appear also in dead matter While we have been waiting for life to be explained in terms of chemistry and physics, a good deal has been done towards stating chemistry and physics in terms of life Of course, no 'explanation' of either live or dead has been given, the behaviour of an atom is just as mysterious as the behaviour of a wasp, and neither 'explains' the other any more than a trypanosome explains a whale But it is something of a comfort if we can believe that at bottom they both behave in much the same way

ATOMS AND ORGANISMS

Picking up such rumours as he might of what is going on in other lines than his own, every biologist must have been struck by the curious familiarity of several of the conceptions which in this century have gone to start the revolution in atomic physics which has pulled the universe in pieces and has perhaps not yet quite succeeded in putting it together again The ideas are familiar because they were originally biological—derived from the study of live things and applied to their explanation Let me illustrate what I mean by some examples

(a) It is one of the characteristics of life that it is exhibited by discrete units which we know as organisms As Powell White says, there is no such thing as living matter, there are only live organisms, and in so far as they are alive 0 1 cow or 1 35 cabbage are impossibilities The live world is made up of such discontinuous pieces so, we now learn, is the dead world Fractional atomic numbers are as impossible as fractional animals the quantum theory tells us that energy is also parcelled out in bits, light consists of particles and, though the ether dies hard, the belief that there is anywhere a continuum—something without a grained structure—has been almost entirely abandoned Discontinuities—in the

[1] Abridged and revised from the presidential address to the Section of Pathology of the Royal Society of Medicine, delivered on Oct. 16, 1928

structure of atoms and in the sizes of the stars—are now as characteristic of the dead world as of the live

(b) When Rutherford and Soddy made people believe that one element really could be derived from another, they did for dead things what Darwin had done for live things indeed they did rather more, for they backed their proposal with experimental proof which neither Darwin nor anyone else had produced in the biological sphere Now, neglecting the time factor, chemical elements are not necessarily more stable than zoological species For practical purposes lead is lead and a dog is a dog, but now we have to apply to both the reservation that they have not always been so, and cannot be trusted to be so indefinitely in the future

The disintegration of the radioactive elements takes place automatically it cannot be started, stopped, controlled, or modified its progress is simply a question of the lapse of time The modes by which organic evolution has been supposed to take place are beyond our discussion, but it is not impossible that it follows the same plan Osborn and other experts hold that the course of any evolutionary sequence of animals is predetermined from the beginning this 'orthogenesis' may be interfered with by circumstances and opportunities, for live organisms are obviously liable to meet conditions in this world which they cannot resist, and which may deflect them from a predestined track or bring them to an end altogether dead elements meet their difficulties elsewhere in the universe

(c) The classification of the elements which has developed by this evolutionary process recalls the familiar schemes of botanists and zoologists which show at once the affinities of animals and plants to one another and (though here there is of course a certain amount of guess work) their phylogenetic relationships Animals were originally classified by characters which we now believe to be largely immaterial—whales were fishes and bats birds About 150 years ago comparative anatomy began to get them into more natural groups, and evolution added the criterion of descent in determining the system which prevails at present

Much the same has happened in classifying the elements into something better than a series of arbitrary pigeon holes Their discovery was the first step, much more difficult than the apprehension of animal species The progress of chemistry then showed that they fell into groups akin to vital genera or families or phyla (we cannot guess at what level the analogy is closest), and the discovery of inorganic evolution and isotopes has brought their relationships to a suggestively biological position Atomic weights are no longer of any great importance what matters in classifying an element is its atomic number, which determines its position in the periodic table and is a summary of its comparative anatomy and a clue to its history An element, for example lead, may arise by more than one line of descent, which is what a biologist would call 'evolution by convergence' The isotopes into which Aston has dissected many of the elements correspond to the groups of closely allied species which embarrass the systematist and with which bacteriologists are familiar enough

(d) If a man and a bicycle are smashed up together in a common catastrophe, the man mends himself, the bicycle does not This capacity of self repair is one of the greatest characteristics of live organisms indeed, if one wishes to define shortly the subject matter of pathology, I doubt if one can do it better than by saying that it is the study of how organisms resist and repair injury In the larger, more complicated animals we find very highly developed a capacity for individual repair which we see daily in the post mortem room and experience continually in our own persons it is so common that we are not impressed by it as much as we should be Simpler things, such as bacteria, have little power of personal repair, but they achieve the same ends by other means, and owing to their numerical abundance and their high capacity for reproduction they can allow the injured individual to perish and readily replace him with a new one Individually or racially, therefore, organisms repair themselves

Atoms seem to be able to do the same Each has a definite structure according to its species as nucleus there are so many hydrogen atoms with their attendant electrons and outside are so many planetary electrons Electrons are continually being detached from atoms by various means, for example, whenever electrical energy is manifested Presumably an atom of, say, iron which has lost an electron is no longer of its normal nature and substance, and such a process would in the end lead to the iron becoming manifestly something which was not iron unless some restorative process was at work It seems clear that injured atoms must be able to pick up electrons from somewhere to replace those which have been lost, a method of individual repair which appears to be efficient enough

(e) Another of the great characteristics of live things is their variability Any measurable quantity of any organism varies, and the values are distributed in some mode akin to the normal

curve Crookes suggested long ago that atoms vary in a similar way, Karl Pearson has imagined a world where contingency replaces cause and effect, and Donnan has emphasised that our chemical and physical constants are statistical, derived from the measurement of an infinite number of individuals, and summarising, perhaps, the average values of a variable population but whether atoms and molecules vary like organisms we do not know—nor is it easy to imagine how we could find out

(*f*) Cane sugar boiled with dilute hydrochloric acid is progressively hydrolysed until practically none of it is left Analysis of the course of the reaction shows that (say) one fifth of the original quantity is decomposed in the first five minutes, one fifth of what remains in the next five minutes, one fifth of what remains in the next five minutes, and so on until the amount left is inappreciable This strange behaviour is accounted for by assuming that the molecules of cane sugar go through some sort of regular rhythmical change, so that at any moment only a certain proportion of them are susceptible to the action of the water at the instigation of the acid there is, I believe, no other justification for the assumption than that it fits the facts, and it cannot fail to remind us of the rhythmical alternations of rest and activity which are common, perhaps universal, in live organisms

If, as Chick has shown, bacteria sometimes succumb to heat or disinfectants on the same kind of plan, it is legitimate to say that they behave like the molecules of cane sugar But it is equally correct to say that the molecules of cane sugar behave like bacteria We cannot tell which is imitating the other all we see is that the behaviour of both is similar The conduct of the bacilli could scarcely have been predicted from a knowledge of what happened to the cane sugar The natural supposition would have been that the molecules of which each bacillus was made up would have been destroyed logarithmically, so that the death point of all the bacilli would have been reached simultaneously—a reflection which illustrates particularly clearly the considerable truth that the discrete unit which is comparable with the molecule of cane sugar is the whole bacillus and not one of its constituent molecules

Reproduction

These analogies between atoms and organisms are suggestive to an imagination which is not afraid to have its wilder moments There are two general objections which will probably occur at once to most biologists (1) that dead elements do not show the multiplying reproduction characteristic of organisms, (2) that organic evolution, on the whole, progresses from the simple towards the complex, whereas what I have called the evolution of the elements proceeds uniformly in the opposite direction The two difficulties are rather closely related

Organic reproduction does two things it produces a fresh version of the old organism and it gives an opportunity for numerical increase its final effect is to leave organisms very much where they were Each foxglove plant in my garden goes to immense trouble to produce about 500,000 seeds, and the wasps toil earnestly all the summer to increase from one to about 1000 But next year there will be just about as many wasps' nests as this and just about as many self sown foxglove plants Darwin taught us the qualitative importance of this superabundance, but, quantitatively, it is made use of only if conditions alter it then enables organisms to fill up any gap in the environment

There may be a tendency for a few large organisms to be replaced by many small ones, but on the whole the capacity for reproduction does not result in more organisms than there were before it merely enables them to adapt themselves to varying conditions If organisms were less complicated, more stable and enduring, less easily injured and less susceptible to their environment, reproduction might be a less important feature of their activities an elephant does not bother about it until it is forty years old or thereabouts, a bacillus does it at an age of about twenty five minutes

With increasing complexity we get diminishing stability, which is presumably why there is no known element with a more elaborate structure than uranium Units which are more complex cannot maintain themselves without the periodical remaking which we call reproduction those which are less complex do not reproduce, because they have no need to do so

There is no reason to suppose that anything so like organisms as to deserve the same name exists anywhere in the universe except on the earth But we cannot confine our speculations about dead things within the same limits The stars are made of much the same elements as the earth, and material transfers take place in both directions meteorites come and nearly all the hydrogen and methane which arises from the decomposition of cellulose by bacteria and *Streptothrix* flies off to celestial bodies which are dense enough to secure its permanent adherence The relevant habitat of

the elements is therefore the universe and, taking this into consideration, it is not altogether clear that something like reproduction does not go on in dead things

Though the elements seem inert and stable enough here and nothing much happens to them except the slow decomposition of those which are, in our environment, radioactive, in the immense heat of the stars atoms not only come to pieces and are dissociated into protons and electrons, but also their basic structure is destroyed, positive and negative electrons fall into one another, and matter is converted into radiation In the heavens the elements disintegrate more completely than a dead cat does on earth, and unless there is somewhere some reconstruction the cosmos is coming to a material end Lodge and Millikan think that in the depths of interstellar space, under conditions of intense cold, energy may once again become matter, radiation be reconverted into electrons which in their turn are recombined again into atoms, and so the various elements are reproduced, Jeans doubts any such regeneration

The duty of a pathologist does not call upon him to interpose his private judgment in so nice and important a controversy, and it would be impudent to say more than that some such process would enable us to have a comfortable faith in the mainten ance of the material universe

If the elements do go through such a cycle, it is possible that what we call their ' evolution ' is more analogous to the death and reproduction of organ isms than to the progressive appearance of more complex forms Very little of the cycle takes place in our own particular corner of the universe, to which the organismal cycle is limited, and it is conditioned by very different circumstances of time and space, but it has much the same result in that it leaves things where they were

Such are some of the ideas familiar in biology which have appeared in the explanations of our ex perience of what is not alive They lead to no cer tain conclusion, they furnish, however, an assem blage of concurring and converging probabilities which encourage one to think it possible that things which are alive and things which are not alive con stitute in effect one series, beginning with hydrogen atoms and reaching up to man, and perhaps on to angels, not arranged in a continuous linear succes sion but on a scheme resembling the phylogenetic line of the animal kingdom The units (or ' wholes ' as Smuts would call them) which make up the series are of progressively increasing complexity, structural and functional, and must be compared against one another as they stand, irrespective of their composition A hydrogen atom, a molecule of albumin, a bacillus, a dog are comparable as such, and it is not necessarily of any moment that hydro gen is the basic stuff of all matter, that proteids are essentials of all live organisms, or that a mammal is made up of many bits, each of which is more or less like a unicellular organism, in no case is the be haviour of the more complex whole simply the sum of the behaviour of its constituents

Such a view satisfies our natural antipathy to a dualistic explanation of the universe and makes the old controversy about vitalism and mechanism largely unnecessary [2] It tells us nothing about the nature of life, by indicating that organisms are analogous to elements, it encourages us to think of life as being as insoluble as gravitation, give up the attempt to make out what it is, and, as Lovatt Evans recommends, spend our time more fruitfully in studying its phenomena If we like to be para doxical, we can say that live things are dead, or if we prefer it, that dead things are alive Both at bottom have much the same characters, and it is unlikely that any sharp distinction between them can be drawn

Filterable Viruses

Our general notion of the structure of the uni verse leads us therefore to expect that we might well meet with things which are not so live as a sun flower and not so dead as a brick, and the pheno mena which we study under the heading ' filtrable viruses '[3] suggest that we now have sight of some of this intermediate group The fluid from a blister in labial herpes, the spleen of a dog with distemper, the blood of a human case of measles or yellow fever, the juice of a tomato plant with mosaic dis ease, the body fluids of a caterpillar with polyhedral disease, all contain a something which will pass through a fine grained porcelain filter, is invisible, is destroyed by boiling or strong antiseptics, and will in each case reproduce the disease from which it was derived when it is inoculated into a suscep tible animal or plant Smallpox, vaccinia, rabies, infantile paralysis, foot and mouth disease, hog cholera, fowl pox, and other diseases show the same phenomenon The bacteriophage is a similar some thing which dissolves the bacteria with which it is associated the Rous cancer in fowls yields another invisible agent which will reproduce the same tumour in other fowls

[2] See J Needham, *Jour Philosoph. Studies*, 1928, vol. 3, p 29

[3] For a recent survey, including bacteriophage, see "Filterable Viruses," edited by T M Rivers (1928), for the Rous virus, *Cancer Review passim* As Rivers points out, *filterable* for *filtrable* seems to be unauthorised on the horrid plural *viruses* see S P E Tract, xix (1925) p 36

If we put the question, Is such-and-such a virus alive or dead ? in the belief that we are asking a crucial question to which there is a definite obtainable answer which would solve our troubles, we put up one of those false antitheses which so often lead us astray The difficulty in most scientific work lies in framing the questions rather than in finding the answers, and by the time we are in a position to know what the crucial question really is, we have generally pretty well got the answer In this case 'live or dead' is a stupid question because it does not exhaust the possibilities Let us see how far viruses conform with what are, in ordinary language, admittably 'live' and 'dead'

Size.—There is no mammal, fish, mollusc, or insect which is not perceptible bare eye any more than there is any bacillus which can be seen without a magnifying glass It is also in a general way true that there is nothing with the properties which we commonly associate with bacteria which is not at some stage in its life visible with the highest powers of the ordinary microscope

The rules seem strangely anthropomorphic Viruses are at or below the limits of microscopic vision (0 2 μ), though just how small they are it is impossible to say In some phases some of them verge on visibility They must be ultimately particulate because all matter is so arranged, and from the readiness with which they are adsorbed on to appropriate surfaces the particles are presumably much larger than the molecules of simple salts Passage through filters with pores of different sizes turns out to be a complicated and dubious method of measurement, and the effects of centrifugalisation may depend more on the specific gravity than the size of the particles it is possible to concentrate solutions of hæmoglobin in the centrifuge Taking one thing with another, and reckoning that some viruses are doubtless larger than others, an average diameter of about 25 $\mu\mu$ (0 025 μ) for the smaller ones seems a reasonable assumption, about $\frac{1}{10}$ the diameter of the smallest bacillus, about the same size as the colloidal aggregates of dissolved hæmoglobin and with room for 200 to 400 proteid molecules

Composition—A diameter of 0 025 μ does not give much room or many facilities for complicated vital actions We do not know what occupies that tiny bulk, we do not even know that viruses are mainly proteid There would be room for a larger number of simpler molecules, though it is doubtful whether in any simulacrum of life this would compensate for the absence of the unique combination of chemical flexibility and physical stability which proteids possess and without which, so far as we know, 'life' does not exist The antigenic quality of viruses (*i e* their power to stimulate animals to produce antibodies) is our only evidence that they contain proteid clinically and experimentally they confer an intense and durable resistance to reinfection which is associated with antiviral properties in the blood serum

Metabolism—The attempts which have been made to demonstrate the production of carbon dioxide by viruses have failed, but the quantities involved are small and the technical difficulties large, so that we cannot regard the evidence as conclusive

Stability and resistance to harmful agents—Some viruses at any rate can retain their activity *in vitro* for several years Some bacteriophages endure for a long time in bacteria free filtrates, the Rous tumour virus can be kept almost indefinitely in dried tumour tissue Others are more labile and are difficult to keep over a period of days There is much the same variability as there is with bacteria and bacterial toxins viruses as a class are not characteristically unstable, evanescent things

A good deal has been made from time to time of their resistance to heat and protoplasmic poisons Here, again, the results are very various and differ with the sort of virus and the conditions of experiment, there are no general rules But there are a remarkable number of instances of viruses which have resisted temperatures up to 75° C, and treatment with chloroform, alcohol, ether, toluol, phenol, acids, alkalis, and so forth As a whole, they are certainly more resistant than vegetative bacteria, but it is not certain that they differ markedly from bacterial spores In several particulars their resistance recalls that of enzymes There is nothing in their size *per se* which should protect them

Capacity for independent life and multiplication—No virus has ever been found wild, that is, apart from the animal or plant in which it usually operates, and there is no convincing evidence that any virus has grown and multiplied in artificial culture Living cells are in all cases necessary, which may be supplied by living bacteria, living animals or plants, or tissue cultures That they really do multiply under these conditions seems beyond question foot-and mouth disease can be passed on from one guinea-pig to another *ad infinitum* by filtrates of blister fluid, the bacteriophage can be transferred indefinitely from one culture of bacteria to another, vaccinia from one calf to another, and so on All the evidence we have is conclusive on that point Viruses are certainly not enzymes Apart from living cells they may for a long time survive,

that is, remain in such a state that, on altering the conditions, they can give rise to their characteristic effect—vaccinia, a sarcoma, bacteriolysis, etc, but there is no evidence that they multiply, and multiplication at the expense of the environment is probably regarded by most of us as the most important criterion of life For their multiplication, young growing cells are especially suitable, and it may be quite necessary The bacteriophage multiplies only with the multiplication of the associated bacteria, and vaccinia, herpes, Rous sarcoma, etc, develop and multiply especially in connexion with the growth of cells which results from local injury Cell injury and cell growth are so intimately related that I know of no case where cell growth can certainly be excluded, but at present we cannot be quite certain that it is necessary It seems also to be true that viruses multiply only in the course of the production of their specific effect

Though the fact of multiplication is plain, it is by no means proved that it is effected in the way which is familiar in bacteria and living organisms generally We put in so much virus and we get out more we have no evidence, nor, I think, the right to assume, that the particles which we get out are the direct descendants of those we put in

It may be that these facts are best explained by supposing that viruses are obligatory intracellular parasites, and that the difficulty of cultivating them on artificial media will be solved when we can imitate sufficiently closely the essential features of the intracellular environment

The Cancer Agent

Such an explanation would do quite well for the viruses that accompany infectious diseases and would cover the facts for the bacteriophage But phenomena are known, surely more or less analogous, which it is scarcely possible to regard as due to parasites of any kind

There is, for example, the agent which induces cells to become malignant, indicated years ago by Haaland and Russell,[4] when they showed that close contiguity with malignant epithelial cells might cause normal connective tissue to grow into a transplantable sarcoma—one of the great discoveries of pathology Unless we suppose that tumour cells pervert neighbouring normal cells by argument, persuasion, example, or some other sort of immaterial communication, we naturally assume that some substance passes out from the one to affect the other All attempts to demonstrate this substance in dead tumour cells or in extracts of them uniformly failed until Rous came across his fowl sarcoma and showed that it could be transmitted indefinitely from bird to bird by dried dead cells or by filtrates which contained nothing that could be seen or cultivated This particular tumour produces the substance in a form so stable that it can be examined and played with when it is detached from live cells With most transplantable tumours it is present in such small amounts, or more likely in such a labile unstable form, that its clear demonstration is not possible the carcinoma sarcoma experiment comes off only with a minority of mouse carcinomas Gye has shown that its activity may be modified, enhanced, or depressed by various conditions, which helps to explain the difficulties and apparent inconsistencies which are met with in its experimental investigation

A fair number of tumours have now been transmitted by filtrates, and there is, I think, no reason to doubt that the production of this carcinogenic substance is a common property of all malignant growths We believe that all pathogenic bacteria, or at any rate all the larger ones, produce extracellular toxins there is no other way in which they can injure the tissues But in many instances they are so unstable that it is difficult or impossible to demonstrate their presence apart from the bodies of the bacilli Nor should we, I think, be too shy of drawing general conclusions from such specially easy and demonstrative examples as Providence has provided for our learning and pushes under our noses, until even our stupidity is bound to take notice diphtheria and tetanus for toxins, the guinea pig's peculiar bronchial musculature for anaphylaxis, mice and tar for tumours, and radium are such sign posts, the Rous tumour is another

Another analogous phenomenon takes us, I think, a step further The products of autolysis of dead cells in the body, in suitable concentration, stimulate tissue growth It is a beautiful self regulating mechanism in which the amount of stimulus is proportionate to the amount of cell destruction, and therefore to the amount of cell growth required, and it is obviously of the highest importance for survival As it normally operates in healing our cut fingers, the final result is simply the restoration of the cells which were destroyed

If the normal restraint exercised by neighbouring tissues is evaded and use made of tissue cultures, the products of autolysis or metabolism (in the form of extracts of tissues, tumours or embryos) stimulate growth indefinitely and a much larger

[4] Third Scientific Report of the Imperial Cancer Research Fund, 175 1908 *Jour Path. Bact* vol 14, p 344, 1910.

quantity of tissue may be obtained than we started with From the autolysis of this a larger amount of stimulating substance may be obtained, and there seems no reason why this process of multiplication should have any limit normal tissues in the physical isolation of tissue cultures are as immortal as malignant tissues in their physiological isolation from the rest of the body

No one would, I think, pretend that these products of autolysis are alive in any ordinary sense of the word They have not received nearly so much attention as they deserve, but they are probably of relatively simple and discoverable constitutions Yet applied to cells they cause growth, and in so doing potentially increase their own quantity, this is very much what the Rous agent does

If we agree to put the products of autolysis in the category 'dead,' by what difference are we to separate the Rous virus as being 'alive'? It cannot be cultivated apart from live cells, it multiplies only under conditions where its specific activity is displayed, its inactivation by chloroform and other protoplasmic poisons does not take it nearer life than are toxins or enzymes, or indeed simple metallic catalysts, and its retention of activity after the drastic methods of purification recently described by Murphy seems definitely to exclude it from 'live' As to its origin, all the evidence seems to concur in indicating that the Rous virus arises *de novo* in each tumour There is no epidemiological evidence that cancer comes into the body from outside, everything we know supports the classical view that it is a local autochthonous disease

Most of the experimental work with the virus has started with an actual tumour, and it is therefore just possible that an agent might be carried along through the whole series which originated somewhere else than in a tumour But experimental sarcomas produced by embryo extract and indol, arsenic or tar have been transmitted by filtrates, and if others have failed to reproduce Carrel's results, I would only remark that, in a question like this, one positive experiment is worth more than a great many negative ones Epitheliomas are easily produced in mice by tar and in men by chronic irritation, and if we believe that all malignant tumours contain more or less of a carcinogenic agent akin to the Rous virus, it follows that we can with a considerable degree of certainty stimulate normal tissues to produce virus It is therefore not very remarkable that Murphy, Leitch, and Brebner have at any rate occasionally demonstrated a carcinogenic agent in preparations of normal tissues (testes, pancreas, and embryo *plus* placental extract)

Infectious Diseases

It is difficult to escape the conclusion that the Rous virus arises in the tumour There is no doubt that it is a means by which a tumour may be experimentally dispersed through any number of available animals, and it is apparently responsible for some at any rate of the metastases which occur in the course of the natural disease But there is no evidence that such a virus ever naturally causes a fresh tumour, and we learn the important lesson that the means by which a disease is propagated may not be the same as that by which it was originally started

The chief way in which the virus of, say, foot and mouth disease differs from the Rous agent, and, going a step further back, from the products of autolysis (or metabolism) which stimulate growth, is that it seems to spread about fairly easily from one individual to another chiefly, I think, from the parallel of bacteria, we take this to imply the possibility of independent life and probably independent multiplication But we have no direct evidence of this all we know is that, like the Rous agent, it can be deliberately dispersed through any number of individuals indefinitely, and that it multiplies only when and where it produces its specific effect The blister which is determined on the foot of an inoculated guinea pig by slight local injury is pre eminently the place in the body where the virus is found in the largest amount, and, trying to be as open minded as we can, we must allow that this may be due either to the lesion being produced where the agent is present in greatest quantity, or to the agent being produced in greatest quantity where the lesion is

Putting aside all bacteriological analogy, we have no proof that the particles of virus which we get out of the lesion are directly descended from those we put in In other words, we have to reopen the question which most of us regard as settled Is the agent the cause of the disease or is the disease the cause of the agent? Another stupid antithesis, for the alternatives are not mutually exclusive both might be true

It might well be said—and I think with a good deal of justification—that it is contrary to all common sense to suggest seriously that the viruses of diseases like smallpox, measles, or rabies arise anew in each infected person It may indeed be nonsense It is evidently more conformable with our general experience and with the epidemiological dogma to which we subscribe to lay stress on the definite way in which each case can be traced to a preceding case, and that to another, and so on, explaining such

examples of apparently spontaneous origin as we meet with by carriers (who harbour the virus without showing any symptoms) and the imperfections of our data rather than by the concurrence of a favourable epidemic constitution of the atmosphere With that point of view I quite agree the evidence that in an epidemic something is passed on from one case to the next seems extremely strong But at the same time I cannot altogether get rid of the uneasy suspicions which intrude when I think of say foot and mouth disease distemper or labial herpes

Distemper seems to be everywhere where there are susceptible animals and if the stock of dogs at Mill Hill can be kept free from it indefinitely it will be a point of much more than technical interest As to foot and mouth disease in which no material connexion between one outbreak and another can be discovered I think that the unbiassed man in the street would say that the facts showed either that the virus was universally dispersed possibly in some common animal (such as the hedgehog [5]) other than the cow or that the disease was continually beginning afresh Labial herpes seems in much the same position Epidemics may be found by ransacking the literature but they are certainly not common Not only has herpes no connexion with itself but also it has a definite association with other diseases —pneumonia and severe catarrhs

I daresay however that some simple explanation will be found for these epidemiological difficulties and that any suspicions that we may have about the origin of these viruses will be allayed Viruses can remain dormant in live animals for a long time and carriers might be activated by a variety of incidents But what are we to make of such a phenomenon as virus III ? Virus III is made manifest by inoculating a filtrate of an emulsion of a rabbit s testis into the testis of another rabbit This procedure is sometimes followed by an inflammatory reaction and the production of intranuclear bodies and if this inflamed testis is emulsified and the filtrate inoculated into another fresh rabbit the inflammatory condition is reproduced thereafter the disease can be carried on indefinitely It is not fatal and after its attack has subsided a rabbit is refractory to further inoculations and his blood serum can prevent infection with active virus

[5] Mr Charles Oldham tells me that at the end of the eighteenth and beginning of the nineteenth century ch rchwardens in Hertfordshire put as high a price (4d) on the head of a hedgehog as on that of a polecat Urchins were supposed to do something to cows which diminished the vield of milk and this was translated into a belief still extant, that they sucked the cow s udders when they were lying down Such expenses were not lightly incurred in those days

If we knew nothing of bacteriology should we not conclude that this virus had been generated by our procedures from the tissues of the normal testis ? The only evidence to the contrary is analogy and the slender fact that the phenomenon happens more easily in New York than in London rabbits I do not know how many people have tried similar experiments with other apparently normal tissues if they had been positive we should certainly have heard about them Leitch s Brebner s and Murphy s successes with sarcoma have already been mentioned and bacteriolysins transmissible in series have been extracted from normal organs

Whatever filtrable virus we think of we meet with the same difficulties A good many people are willing to believe that the bacteriophage is generated by its bacillus—which is probably the truth They would explain the way in which each bacteriophage more or less fits its own bacillus by its having originate l from that bacillus Others see in their multiplicity evidence that bacteriophages are really live organisms with the characteristic variability and adaptability It is perhaps more than a coincidence that it is in another group of plants that the same difficulty has arisen the agents of plant mosaic diseases have never been found apart from affected plants they have not been cultivated no one can be sure whether there is one virus or many viruses

If viruses do originate in tissue cells what are we to imagine that they are ? Béchamp s ghost would answer microzymes as I told you seventy years ago Altmann would say bioblasts others micellæ and even mitochondria and all the people who have imagined that cells are made up of much smaller essential elementary live particles would see in the present development the fulfilment of their prophecies They cannot all have been exactly right bioblasts are quite big and mitochondria (which some have supposed to be symbiotic organisms) are also visible and not only to the elect But it may well be that they were making as shrewd guesses at the truth as Prout did when he suggested that all elements were ultimately compounded of hydrogen Until Harrison did it we had not suspected that the cells of warm blooded animals could be cultivated *in vitro* If they can live and multiply divorced from their proper community is it altogether impossible that parts of cells might have something of a separate existence also just as electrons may operate apart from atoms ?

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specialised carnivores, and the manner—if any—whereby the algæ are digested is yet to be ascertained

Mr A G Nicholls, of the University of Perth, besides rendering great assistance to the leader of the expedition with his work on corals and beginning work on the calcium content of sea water, has taken charge of the work on the life history of the 'black lip pearl oyster' (*Meleagrina margaritifera*) An area on the reef flat has been marked off with a stout fence of mangrove wood, ample settling surface for spat being provided not only by the mangrove stakes, but also by numerous empty clean clam shells Some 450 oysters have been placed in this enclosure Gonad samples are taken fortnightly, and one breeding period, during the first week in November, so far noted Mr G W Otter is carrying out a survey of the varieties numbers, distribution, and powers of destruction of the rock borers, especially the lamellibranchs and is obtaining results of interest He is also working on the wood boring Teredinidæ

Collecting both on the reef and from the bottom near reefs by dredges and the Agassiz trawl—the latter from a 20 foot whale boat with a 6 h p engine purchased locally—has proceeded apace, but intensive collecting is being held over until after the summer, when it is hoped that an additional boat will be chartered, and excursions can be made far afield For the time being, the expedition is doing its best work by concentrating on the intensive study of the conditions on and around this small reef, and from the various lines of research so vigorously being prosecuted there is every indication that at the end of the year here, there will be available for publication the most complete account to date of the conditions under which this type of coral reef exists

Mr J A Steers assisted by Mr M Spender and Mr C Marchant, who constitute the geographical section have cruised northward from Townsville in a launch chartered there to Flinders Islands (north of Cooktown) and back calling at Low Islands for several days on both outward and return trips They have examined many reefs and coral cays in this long stretch, and have been able to form a very clear idea of the vastness of the problem confronting geographers in this region Mr Steers is now on his way back to England, but Mr Spender and Mr Marchant are to arrive at the Island shortly the latter for two months only, the former, with periods of surveying on selected cays and on the mainland opposite the island, for the remaining period of the expedition

Obituary

Prof Bashford Dean

Dr BASHFORD DEAN who died at Battle Creek, Michigan, U S A on Dec 6 1928, was equally eminent as an ichthyologist and as a student of medieval armour He acquired both interests in early boyhood in circumstances which fostered them and he continued to pursue both until the end For several years he was the active curator of fishes in the American Museum of Natural History New York where he planned the public exhibition of fossil and existing fishes For a still longer period he was curator of arms and armour in the Metropolitan Museum of Art, New York, and likewise planned the installation of the collection In each case he largely added to the collection by the acquisitions he obtained during his numerous and extensive journeys in the Old World

Dean was born in New York on Oct 28, 1867 and was educated first at the College of the City of New York, where he made good progress in zoology Next, in 1886, he entered Columbia College, where he studied geology and fossil fishes under Prof J S Newberry, whose researches on Devonian fishes he afterwards continued In 1890 he graduated as Ph D with a thesis entitled "Pineal Fontanelle of Placoderm and Catfish," which was published by the New York State Commission of Fisheries Meanwhile, he had already become tutor in natural history in the College of the City of New York, and had also been appointed assistant on the Fisheries Commission He thus had early experience both of teaching and of research In later years he was for a time one of the professors of zoology in Columbia University where he had some brilliant pupils but most of his energies were devoted to research and the enlargement of the collections of which he had charge

Dean's training led him to take the widest view of ichthyology, and he was equally well versed in the methods of embryology and of palæontology His outlook is well shown in his useful handbook on "Fishes Living and Fossil" which was published in the Columbia University Biological Series in 1895 It deals mainly with the lower and older groups of fishes, which are of the greatest interest from the evolutionist's point of view It regards them in all aspects, and facilitates comparisons by adequate synoptical tables and pages of clear figures drawn by himself It summarises the knowledge and ideas of the time, expressing several opinions which Dean's own researches afterwards caused him to modify His latest and most important volume, on "Chimæroid Fishes and their Development," published by the Carnegie Institution of Washington in 1906, displays the same wide scope It combines embryological observations on specimens which he collected in Japanese seas with extensive anatomical research and numerous descriptions of important fossils It reaches the conclusion now generally accepted, that the chimæroids are highly specialised sharks

Among Dean's papers on fossil fishes may be specially mentioned those on the Devonian shark which he named *Cladoselache*, and those on the armoured Devonian fishes commonly known as Arthrodira He showed that the fins of *Cladoselache* could only be explained on the theory that

the fins of fishes had been derived from continuous fin-folds He also proved that the body-cavity of this primitive shark extended backwards almost as far as the tail fin, by examining microscope sections of the fossil which revealed the structures of the kidney His researches on the Arthrodira led him to the conclusion that they were not Dipnoi, but while recognising them as much more primitive fishes, he failed to discover their connexion with ancestral sharks which Stensiö has lately demonstrated Dean also devoted much attention to the supposed Devonian lamprey *Palæospondylus*, which he regarded as wrongly interpreted he thought it might be the larva of some larger fish

Dean made many observations on the embryos of all the existing ganoid fishes, the Port Jackson shark, and certain hag fishes, besides the chimæroid fishes already mentioned He prepared series of beautiful drawings, but many still remain unpublished His memoir on the embryology of *Bdellostoma stouti*, contributed to Carl von Kupffer's "Festschrift" in 1899, may be specially mentioned as illustrated by some of his finest drawings

Dean also took every opportunity of studying living fishes, and he made many important observations on the specimens of *Ceratodus* living in the London Zoological Gardens, which were published in the *Proceedings of the Zoological Society* in 1906 and 1912

From the beginning of his career, Dean realised the difficulty of becoming acquainted with existing knowledge of his subject, and devoted much time to the preparation of an adequate bibliography By 1910 this had become so unwieldy that he felt he could not complete it himself, and he then succeeded in obtaining the co operation of the American Museum of Natural History for the final preparation and publication of the work Under his general direction, the two volumes of the index to authors and titles were extended and edited by the late Dr C R Eastman, and published in 1916–17 The third and final volume, extended and edited by Dr E W Gudger with the co operation of Mr A W Henn, includes an exhaustive subject index, and was published in 1923 This great work of reference, which extends to the year 1914, is of inestimable service to ichthyology, and gained for Dr Dean the D G Elliot medal of the United States National Academy of Sciences, immediately on its completion

In 1893 Bashford Dean married Miss Alice Dyckman, who belonged to one of the oldest Dutch families of Manhattan Island, and his wife not only furthered his life work by her sympathy and help, but also accompanied him on his numerous and extensive travels He was as well known among the zoologists of Europe as among those of North America, and he had a large circle of friends in Britain He was a corresponding member of the Zoological Society of London His always delicate health handicapped him in his activities, but his enthusiasm never flagged, and his old world courtesy and friendliness endeared him to all who were associated with him A S W

PROF E H L SCHWARZ

THE death of Prof Ernest H L Schwarz, professor of geology in the Rhodes University College, Grahamstown, leaves South African geology much poorer owing to the loss of his enthusiasm, originality, and ability as a teacher and lecturer Prof Schwarz was born in London on Feb 27, 1873, and educated at Westminster School and the Royal College of Science His father was a London merchant engaged in the South American trade, but he went to South Africa, being attracted by its mining development, and in 1895 settled in Johannesburg, where he became editor of the *Scientific African*

Prof Schwarz was more interested in academic than in applied geology, and in 1896 joined the Geological Survey of Cape Colony and spent nine years in its service under Dr A W Rogers He investigated the older rocks of Cape Colony, and in co operation with Dr Rogers correlated them with those of the Transvaal During his surveys of the Cape Devonian beds he described the complex folds in the Bokkeveld Series, the glacial beds in the Table Mountain Sandstone, and in an account of a collection of rocks from Tristan da Cunha founded his Flabellites Land for a Devonian continent occupying the South Atlantic and extending northward into the Mississippi Valley In an account of some Karroo beds he suggested that certain tuffs had been formed by the deep seated shattering of the granite basement He made important contributions to the Cretaceous and Kainozoic geology of the eastern Cape Colony, and described Baviaan's Kloof (1903), with the series of tectonic basins which he called 'fault pits', he gave the name of the Alexandria Formation to a succession of beds which have been recorded as ranging from the Upper Cretaceous to the Pliocene He also urged the great influence of marine planation in forming the plateau of the same part of Cape Colony

In 1905 Prof Schwarz was appointed to the chair of geology at Grahamstown, and had the opportunity to give play to his interests in the speculative sides of geology and cosmogony, and in his "Causal Geology" (1910) he applied some of the natural corollaries of T C Chamberlin's planetesimal theory to later geological history In connexion with his educational work he prepared an excellent summary of the geology of South Africa and a small work on African geography

While working in the backblocks of the Cape, Prof Schwarz had been impressed with the diminution of the agricultural population and attributed it to growing desiccation of the country The reduction of Lake Ngami from a great lake to a swamp, and later to a bare plain, seemed to Schwarz one effect of a process that was doing widespread injury throughout South Africa He published his conclusions in 1920 in "The Kalahari, or Thirst land Redemption," in which he advocated the diversion from the Upper Zambezi of some of the flood waters that now rush wasted to the sea He held that much of the water could be turned back

into the dry valleys and lake basins of the Kalahari and the climate of the interior of South Africa materially improved The scheme has been set aside as too costly, but Schwarz was probably correct in his views that the Kalahari has suffered by the capture by the Zambezi of some of its rivers and that some of the water could be restored to the ancient channels He, however, probably exaggerated the effects that would follow from this expensive undertaking

Prof Schwarz's book on the Kalahari and its natives, published in 1928, recorded his observations during a canoe voyage across that country when wet seasons had refilled its lakes and rivers and thereby thrown doubt on his theory of the progressive desiccation of South Africa He also described the natives of the Kalahari, and advanced views which, as usual, were of daring unconventionality His interest in irrigation projects led to his study of the river system of Africa as a whole, and it was probably in connexion with its problems that he was visiting St Louis in Senegal, where he died on Dec 19

Schwarz's conclusions were often highly speculative, and his great scheme for the irrigation of the Kalahari has been rejected as impracticable, but he has left many contributions of permanent value to the geology of Cape Colony, and his death will be widely regretted owing to his gifts of friendship and the stimulating originality of his views

J W G

DR W G SMITH

SCIENCE has lost a distinguished agricultural botanist in the death of Dr W G Smith, who died in Edinburgh on Dec 8, 1928 Dr Smith was born in Dundee on Mar 20, 1866 He graduated in pure science in the University of St Andrews, and after a short period of teaching in the Morgan Academy, Dundee, became a lecturer in agriculture under the Forfarshire County Council Later he acted as a demonstrator in botany in the University of Edinburgh under the late Sir Isaac Bayley Balfour Proceeding to Munich, he took a two years' course of study, gaining there in 1894 his doctorate of philosophy for a thesis entitled "Untersuchung der Morphologie und Anatomie der durch Exoasceen verursachten Spross und Blatt Deformationen" This thesis was afterwards translated into Italian Another result of his sojourn in Munich was his translation of von Tubeuf's standard work on the "Diseases of Plants by Cryptogamic Parasites," which appeared in 1897 On his return from Germany, Dr Smith became lecturer in botany in the University of Leeds, where he remained for eleven years In 1908 he was appointed chief of the biology department of the Edinburgh and East of Scotland College of Agriculture For the last twenty years the College was his headquarters Recently, under the scheme for the development of research work in agricultural problems, Dr Smith was appointed advisory officer in agricultural botany to the Board of Agriculture for Scotland

Three fields in botany attracted Dr Smith's particular interest, and in each of these he was acknowledged an expert His earlier training under von Tubeuf gave him a keen interest in researches on the diseases of plants, especially those of concern to agriculture and horticulture Along with his brother, Robert Smith, who died young, he instituted the first detailed botanical surveys in Britain Numerous papers dealing with ecological botany appeared from his pen Amongst these were botanical surveys of Forfar and Fife and of various areas in Yorkshire and Teesdale He was always in close touch with Warming and other distinguished Continental ecologists The third field in which Dr Smith distinguished himself was the study of grassland, especially of hill pastures, including the utilisation of heathland and the eradication of bracken

These three phases of his work were combined into one harmonious whole, and no one was better fitted from his experience and patient research to act as advisory officer on matters concerning agricultural botany Throughout most of his career he was engaged in the instruction of students, by whom he was held in the highest regard Teaching duties, onerous as they were, did not hinder him from pursuing a continuous series of investigations, and the record of his published papers extends from 1894 until 1928

In 1903, Dr Smith received the award of the Back Grant by the Royal Geographical Society for research in the geographical distribution of vegetation in England It is of interest to record that of his four children, two pairs of twins (boy and girl), three have had distinguished university careers, each taking first class honours, while one is still an undergraduate The elder son is professor of botany in Grahamstown University, South Africa

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WE regret to announce the following deaths

Mr R H Cambage, C B E, president of the Australian Association for the Advancement of Science and of the Australian National Research Council, and a past president of the Royal Society of New South Wales, on Nov 28, aged sixty nine years

Prof H B Fine, professor of mathematics and dean of the departments of science at Princeton University, distinguished for his work in pure mathematics, on Dec 21, aged seventy years

Mr W T Gauss, a grandson of the illustrious German mathematician, Carl Friedrich Gauss, and through his mother a nephew of the noted German astronomer, Friedrich Wilhelm Bessel, on Nov 14, aged seventy seven years

Major General Sir Gerard Heath, a former chairman of the Building Research Board of the Department of Scientific and Industrial Research, on Jan 9, aged sixty five years

Prof M J M Hill, F R S, emeritus professor of mathematics in the University of London and president of the Mathematical Association, on Jan 11, aged seventy two years

Dr Alexander A Maximow, professor of anatomy in the University of Chicago and formerly professor of histology and embryology in the Russian Imperial Military Academy of Medicine, on Dec 3, aged fifty four years

News and Views.

THE Gold Medal of the Royal Astronomical Society has been awarded to Prof Ejnar Hertzsprung, of Leyden Observatory, for his determination of the distance of the Magellanic Clouds and other pioneering work in stellar astronomy Prof Hertzsprung's work is characterised by definiteness and originality it includes researches in photometry, study of change of period in variable stars, investigations of the spacial distribution of Cepheids and other bodies, special studies of clusters, and researches in celestial spectroscopy He was the first (1906) to emphasise the evidence for distinction between giant and dwarf stars His work on the relation between colour, proper motion, and apparent magnitudes of stars has been a noteworthy contribution His early application (1906) of the theory of radiation to considerations of stellar temperatures led him to be among the first to estimate the angular diameters of stars He found the key by which Cepheid variables can be used to determine stellar distances Miss Leavitt at Harvard had found a relationship between the apparent magnitude and period of Cepheid variables in the lesser Magellanic Cloud Hertzsprung saw that this implied a relationship between actual luminosity and period He then by means of solar motion deduced the parallax of thirteen bright Cepheids and thus their absolute luminosity, and the constant of the period luminosity relation He derived the distance of the lesser Magellanic Cloud as 10,000 parsecs This work was published in 1913, and the method has since been extensively employed by Shapley, Hubble, and others in the determination of the distances of remote clusters and nebulæ

SCOTLAND has been slow in developing the bird sanctuary movement Apart from the fine enclosure of some 40 acres at Duddingston Loch, near Edinburgh, there is no considerable reserve in the country, although the vast areas of the deer forests have acted in many ways as real reservations A welcome announcement, therefore, is contained in a leading article in the *Scottish Naturalist* (p 166, 1928), that a new sanctuary of 70 acres is to be created at Possil Loch, in the neighbourhood of Glasgow The area is well known to naturalists on account of its wealth of plant and insect life, and the use made of the Loch by birds as a resting place on their migrations The extension of Glasgow and the increasing presence of irresponsible marauders, egg collectors, and bird nesters has threatened the existence of the marsh as a nature lover's paradise, so that the natural history societies of Glasgow and related bodies have been compelled to acquire the ground in order to preserve its amenity They have been generously met by the owners of the estate, and propose to administer the area so that its natural beauty and wild life may best be preserved, while reasonable access will be secured to the public for all time It is estimated that a sum of £2000 will be required for the purchase and maintenance of this bird and botanical sanctuary, and the Committee appeals for donations, which should be sent to Mr J M Crosthwaite at 207 West George Street, Glasgow

WE are informed that the appeal for subscriptions to a memorial to the late Sir William M Bayliss and Prof Ernest H Starling has up to the present resulted in a sum which, with interest, and apart from subscriptions which are still arriving, will amount to above £2600 The sum has been contributed principally by personal friends, relations, and pupils of these distinguished physiologists, but very liberal subscriptions have also been received from their admirers in America, various European countries, chiefly Germany, from learned societies, and from various physiologists and members of the medical profession from all parts of the world A small part of the fund has been employed for the provision of a simple memorial tablet designed by Prof A E Richardson, F R I B A, bearing their names, which will be erected in the entrance hall of the department of physiology and biochemistry, where it will occupy a suitable place over the bust of Sharpey A material memorial or an annual lecture would, however, have seemed a smaller thing to Bayliss and Starling than the provision of means whereby young workers of suitable training and ability might be attracted into their chosen subject The bulk of the sum, therefore, will be used for the creation at University College, London, of a Bayliss and Starling Studentship, which will be open to any graduate in science of any university, or any graduate or undergraduate in medicine of suitable standing, to enable him to spend a year or more in such training in physiology and biochemistry as would fit him for research For this purpose the sum of £2500 will shortly be transferred to the University of London to be held in trust for the creation of such a studentship The governing body of University College has agreed to assist this scholarship in a very material way by remitting all fees for instruction and ordinary expenses payable by the selected candidate It is hoped to make the first award of the scholarship in June of the present year

THE Zoological Society of London has for a hundred years been a force working for the diffusion of Nature knowledge amongst the people, and during the last quarter of a century its progress has been extraordinary It is fitting, therefore, that the centenary of the granting of its Royal Charter, which followed three years after the founding of the Society in 1826, should be properly commemorated It will be celebrated during the present year by a representative gathering of fellows and of delegates of other societies at the annual general meeting on April 29, by an evening reception for the 8000 fellows and their guests in the Gardens during the summer, and by the publication of two interesting memoirs The first of these is a historical account of the origin and development of the Society and of its general and scientific work, written by Dr P Chalmers Mitchell, the second, a list of every species of mammal, bird, reptile, batrachian, and fish that has been exhibited alive in the Gardens since their foundation The list will include popular and scientific names, as well as a certain amount of synonymy and references to descriptions and figures Anyone who has regularly used P L

Slater's "List" of 1896 will appreciate the labour involved in the new venture, and its potential value for the creation of a common standard of English specific nomenclature

BOUVET Island and Thompson Island, in the South Atlantic, have been much discussed lately owing to rival political claims and the uncertainty as to the existence of Thompson Island This island has been searched for several times unsuccessfully since Capt Norris reported it in 1825 Com R T Gould recently showed that to the north east of Bouvet Island, centring about lat 54° S, long 4° 35′ E, there is an unexplored area of the ocean in which Thompson Island probably lies The whole problem is reviewed in an editorial article in the *Geographical Journal* for December, which is accompanied by reproductions of Norris's sketches, or copies of his original sketches, now preserved in the Admiralty Library From the evidence available, the suggestion is made that the land first sighted in 1739 by Captain Lozièr Bouvet and named by him Cap de la Circoncision was not the Bouvet Island of to day but Thompson Island Bouvet placed his cape in lat 54° 6 S and he cruised so far as 54° 40′ S These positions agree reasonably well with the probable position of the two islands Bouvet estimated that the extent of land which he saw was forty five miles, but his sight was continually hampered by mist and ice It is therefore possible that Bouvet really sighted both islands Furthermore, it is now clear, as has been previously supposed, that the Liverpool Island of Norris is the same as Bouvet Island Lindsay Island of Lindsay (1808) is the same island The problem of Thompson Island is further complicated by the failure of the *Norvegia* to find the island in a recent lengthy search in the area of sea indicated above

DURING the War, when coal was scarce and its price very high, surplus electrical energy was used to heat boilers It was found that this not only effected savings in the coal bill but also could be used economically in working electric plant Two applications of the principle have come into practical use Small thermal accumulators are used for domestic purposes and boilers are regulated electrically so that they can supply a sudden demand for steam For heavy loads and voltages exceeding 500, the water itself is used as the resistance when alternating current is available If the frequency of the supply exceed 15, there is no risk of explosive gases being generated in appreciable quantity In *Engineering* for Jan 4, a complete description is given of the electrically heated plant which is made by Messrs Sulzer Bros of Winterthur Pressures up to 16,000 volts can be utilised and so the expense of transformers can be saved Water containing salts conducts electricity much better than soft water Water at 59° F has an average resistance of from 1800 to 6000 ohms per cubic centimetre At 212° F its resistance varies from about 500 to 2000 ohms per c c and it is about 15 per cent less at 400° F Boilers should be constructed with their electrodes completely immersed and connected with the top of the boiler by an insulating tube If this is not done, sparking occurs to the surface of the water when the voltage exceeds 1000, and this causes the load on the boiler to fluctuate and the electrodes to wear away rapidly Tests prove that the efficiency of large electric boilers is exceedingly high For domestic purposes, electric thermal storage presents many advantages The whole of the heat supply in spring and autumn can be supplied by electrical energy, the coal fire being used only during periods of severe cold

A FEW years ago broadcast listeners were greatly interested in the technical side of the service, and so were not very critical of its quality The more one listens the less tolerant one becomes of interruptions and of poor quality service In continental areas the number of available wave lengths is rapidly diminishing The number of high power stations is being reduced, and the other stations are using wave lengths which are continually getting shorter in order to prevent being interfered with by other waves In some countries the broadcasting is being carried out in a haphazard way, and their listeners therefore have not been educated to expect a good service Hence their broadcast radiations interfere with the high quality reception demanded by residents in other countries In a paper read to the Institution of Electrical Engineers by P P Eckersley, T L Eckersley and H L Kirke, on Jan 2, this aspect of the broadcasting problem was emphasised They consider it most unfortunate that the broadcasting problem should be discussed by many as if it were a political and not a scientific problem In their opinion, the best way of attacking it is to attempt to design an aerial so as to make it a radiator which practically emits only rays which are initially parallel to the surface of the earth It is the existence of the other rays that are so detrimental to a good broadcasting service These rays interfere with the service from very distant stations and intensify fading and bad service in the local service area To obtain horizontal radiation high aerials are necessary Radio engineers in the past have been chary about using wave lengths less than 300 metres, as they were afraid that this would in practice seriously limit the service area As the authors point out, however, it has to be remembered that limitations are inevitable and it is far better to have a limited service than one which suffers continually from interference

TRINITY COLLEGE, Hartford, Connecticut, does an interesting thing in the way of encouraging good general reading among its students, who are, one may suppose, roughly of what we call 'university status' in England A list of recommended books is drawn up in ten classes, ranging from natural science which is put first, through various types of history, on to various types of literature These books are actually grouped in one bookcase in the College Library "Students are expected to do one hundred points of reading in a year, and write up each point on at least half a typewritten page One hundred pages of ordinary novel reading is credited as one

point," and extra credit is allowed for more difficult subject matter They must select at least one title from each of eight of the ten classes of book mentioned Not more that a fifth may be fiction One would like to know how the plan really works, what the students think of it, and how much they retain of the books thus read Independent reports from the professorial and the student side would be welcome before we embark on the experiment on any large scale in England, where undergraduates are more mature, less *in statu pupillari* than they are in the United States For the list itself, one can have nothing but praise It is admirable alike for what it includes and what it leaves out It is clearly the work of humane and philosophically minded persons who agree with Comte in putting first in their library 'les œuvres de synthèse,' books on the history and the philosophy of science But when they mention by name in their preface some of the 'muck raking' novels which they refuse to include in their list, one might be afraid that they would increase the circulation of the proscribed books in any less well ordered institution than Trinity College, Hartford

OPERATIONS at Ur were resumed by the British Museum Expedition in November The results of the first month's excavation, which were described by Mr Leonard Woolley in the *Times* of Jan 11 if less spectacular than those which opened the season last year, are none the less remarkable for the fresh light they throw on the funerary customs of the early Sumerians and the promise they hold out for the immediate future Last year's work recovered the plan of a king's grave Now a similar grave has been seen in section, which as Mr Woolley points out is scarcely less illuminating The first indication of the nature of the evidence which was being brought to light was a layer of reeds extending up to the walls of what appeared to be a small room of mud bricks Under the reeds were innumerable fragments of clay pots, animal bones, and several human skeletons which lay on a floor of beaten clay This was clearly a subterranean building, of which the contents were in the nature of a votive deposit Further examination showed that it lay in a vertical shaft and was an element in a new form of ritual in which, after the burial of the king and the slaughter of his retainers, votive offerings were placed in the earth at intervals as the shaft was filled in, until finally it was stopped with a subterranean chamber containing offerings This in turn was covered with earth, and perhaps the whole completed with a funerary chapel as a superstructure

IN another shaft at Ur, which appears to be that of a queen's tomb, a remarkable series of offerings included a coffin burial, and concluded after a considerable interval in the remains of a funeral feast immediately above the dome shaped roof of a burial chamber in which were six bodies, four men servants, a maid servant, and the queen in whose honour the tomb had been built Beside the conventional gold head-dress, the funerary appointments included a pin of unusual type and a gold enamel cylinder seal with scenes of feasting and musicians The tomb of a small girl had a miniature replica of the conventional gold head dress

MR L S B LEAKEY, who returned to Africa in September last to resume excavations in Kenya with the assistance of a grant from the Royal Society, has made a discovery relating to early man which, if the conditions are as reported in the *Times* of Jan 12, is of great importance Mr Leakey is excavating in a cave known as 'the Gambles' in the Elmenteita district, one of the districts in which his discoveries of previous seasons were made (see NATURE, July 16, 1927, p 85) This cave shows a stratification of fourteen chronological layers extending from the earliest times down to its modern occupation by the N'dorobo In the stratum of the second of the African pluvial periods into which the early deposits have been classified, Mr Leakey has found a complete human skeleton, which is said to have been removed undamaged except for a pickaxe hole in the skull The skeleton, which was associated with a rich industrial development of tools, was found with the knees under the chin The type is definitely that of *Homo sapiens* It is stated that Mr Leakey believes that this is the earliest predecessor of Aurignacian man yet found, his opinion being based upon the view that the various pluvial periods of East Africa are to be equated with the glacial epochs of Europe In the stratification of the cave a relatively brief Mousterian occupation follows the second pluvial period, and in the third pluvial period the cave was occupied by a people of an Aurignacian culture, who, however, made pottery The occurrence of pottery with early types of culture in Kenya had already been recorded by Mr Leakey, but it suggests caution in accepting a high dating Nowhere else does pottery occur at so remote a period Neither here nor in any other area do known conditions suggest why East Africa should be exceptional in this respect

ON Jan 15 Dr F A Freeth delivered the first of a course of two lectures which he is giving at the Royal Institution on "Critical Phenomena in Saturated Solutions" Dr Freeth pointed out that the ordinary 'commonsense' view of solutions is apt to be disturbed at high temperatures and pressures near the critical state For example, it is generally assumed that pressure will cause a vapour to condense, the reverse phenomenon, namely, the turning of a liquid into a vapour by means of increased pressure, is, however, almost a universal phenomenon, although the conditions under which it occurs are sufficiently remote from those of ordinary life to make it appear singular If we take a saturated solution of a substance and heat it in a closed space, it may just boil, as does a solution of common salt in water, and it is possible to have two solutions which boil at ordinary temperature, one a solution of, say, sodium nitrate and water, the other a solution of water and the salt There may be a considerable range of temperature, however, in which it is impossible to obtain a solution of any kind, the best known example being that of anthraquinone in ether This state of affairs holds

for a very large number of salts and water It has not received much experimental attention on account of the great practical difficulties of realising the conditions Finally, it was pointed out that just as a liquid should be caused to vaporise by increase of pressure, so in certain circumstances could a solid

At a meeting held in New York on Dec 27, a new scientific society, the Acoustical Society of America, was formed, to bring together workers in all branches of pure and applied acoustics Among its activities will be the provision of a medium of publication for papers on acoustics, for which there is acute need, such papers have hitherto been widely scattered Elected to temporary office were *President*, Dr Harvey Fletcher, of Bell Telephone Laboratories, *Vice President*, Prof V O Knudsen, of the University of California, *Secretary*, Mr Wallace Waterfall, of the Celotex Company, *Treasurer*, Mr C F Stoddard, of the American Piano Company A committee was appointed by Dr Fletcher to consider the details of organisation, and the first regular meeting was arranged for some time in April at Bell Telephone Laboratories

Sir Hubert Wilkins, in a dispatch to the *Times* announces that he made a second flight from Deception Island on Jan 10 He passed southward for about 250 miles looking for an advanced base that would be more favourable than Deception Island Fog, however, prevented him finding one and forced him to return without adding to his discoveries He has decided to postpone further efforts until next season, when he hopes to find a base on the continent to the south of the group of islands of which he has proved Graham Land forms part If he is successful in reaching such a base by ship, Sir Hubert Wilkins will be in a position to try a flight along the edge of the continent towards South Victoria Land Continuity of land below his line of flight will ensure some possibility of return to his base if engine trouble or other causes should force him to descend

Owing to various developments which have taken place in connexion with the fertiliser interests of Imperial Chemical Industries, Limited (particularly the formation of Scottish Agricultural Industries, Limited), and to the inauguration by the Government of the agricultural credits scheme, the project which the company had in mind for the inauguration and support of a special Imperial Grassland Association has proved unnecessary and incapable of complete realisation without duplication and overlapping of effort Lord Bledisloe, who had been invited to become the chief of this new organisation (and who, it will be remembered, relinquished his membership of the Government with that object in view) has retired from his association with the project While acknowledging Lord Bledisloe's willingness and ability to undertake the work which would have been entailed had the scheme been proceeded with, Imperial Chemical Industries, Limited, realised that it had no alternative but to release Lord Bledisloe, who will continue, however, to act in an advisory and consultative capacity on agricultural questions generally

An admirable account of the proceedings of the ninth annual conference of the Apis Club, which was held at Geneva and Berne on Aug 12–16 last, under the presidency of Dr Otto Morgenthaler, appears in the *Bee World* for November and December last The meetings were attended by a number of distinguished workers, of several nations, representing both the practical and research sides of apiculture Among the various papers read at the conference and published in this journal, Dr E Elser's account of the micro technique involved in investigating the brood food over the last forty years is of special interest to biologists After discussing the now well known remarkable work of von Planta, modern methods of determining the constituents of the larval food are described The next conference will be held in Berlin in 1929, under the presidency of Prof Ambruster

The Council of the Geological Society has this year made the following awards Wollaston Medal to Prof F J Becke, of Vienna, in recognition of the value of his researches in petrology, Murchison Medal to Dr C A Matley, in recognition of the value of his researches on stratigraphical geology in various parts of the British Empire, Lyell Medal to Dr A Morley Davies, in recognition of the value of his researches in invertebrate palæontology, Bigsby Medal to Prof P G H Boswell, for his valuable researches in sedimentary petrology and stratigraphy, Wollaston Donation Fund to Dr R Campbell, in recognition of the value of his researches in Scottish petrology and stratigraphy, Murchison Geological Fund to Mr L R Cox, for his valuable researches in invertebrate palæontology, especially in connexion with the Lamellibranchiata, a Lyell Geological Fund to Mr C Edmonds, in recognition of the value of his researches on the Lower Carboniferous rocks of the Whitehaven district, a second Lyell Geological Fund to Dr E O Teale, for his contributions to the geology of Victoria and of Africa

At the meeting of the London Mathematical Society, to be held on Feb 14, at 5 P M, at Burlington House, Prof O Veblen, of Princeton University, will deliver a lecture on "Generalised Projective Geometry" Members of other scientific societies who may be interested are invited to attend

A violent earthquake was registered at seismological observatories on Sunday, Jan 13 The record at Kew Observatory where the first tremors were received at 0 hr 14 min 49 sec G M T, indicates that the epicentre was near the Kurile Islands, Lat 50 N, Long 150° E This location is confirmed by the information received from Bombay, Helwan, and Stonyhurst

The Annual Report for the year 1927 of the South African Institute for Medical Research, Johannesburg, by the Director, Sir Spencer Lister, has recently been issued The work of the Institute comprises routine examinations of material for medical practitioners, as aids to diagnosis, and research work The last named included during the year field work on plague, determination of the types of the tubercle bacillus among

South African natives, investigations on pneumonia, cerebro-spinal fever, effects of dust inhalation, and the estimation and elimination of dust in 'dusty' occupations, and a mosquito survey in Zululand

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —An assistant in the technical education branch of the department of the West Riding Education Committee—The Education Department County Hall, Wakefield (Jan 28) A public analyst and agricultural analyst for the City of Cardiff—The Medical Officer of Health, City Hall, Cardiff (Jan 31) An agricultural economist at the West of Scotland Agricultural College—The Secretary, West of Scotland Agricultural College, 6 Blythswood Square, Glasgow (Jan 31) A technician in the department of zoology of the University of Edinburgh, for assistance in research and the preparation of microscopic slides for class use, also a museum curator in the same department — The Secretary, The University, Edinburgh (Feb 1) A research assistant in the Leather Industries Department of the University of Leeds—The Registrar, The University, Leeds (Feb 4) A bio chemist at the antitoxin establishment of the Metropolitan Asylums Board — The Clerk, Metropolitan Asylums Board, Victoria Embankment, E C 4 (Feb 6) A principal of the Dundee Technical College and School of Art—The Secretary, Technical College, Bell Street, Dundee (Feb 8) A head of the mechanical and civil engineering department of the Sunderland Technical College—The Chief Education Officer, 15 John Street, Sunderland (Feb 9) Two appointments in the Forest Service of Burma—The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, S W 1 (April 6) A full time teacher of engineering at the Verdin Technical School, Northwick —The Director of Education, Dept 'C' County Education Offices City Road, Chester Two junior assistants (male) under the directorate of ballistics research, Research Department, Woolwich—The Chief Superintendent, Research Department Woolwich, S E 18 A secretary to the Pharmacopœia Commission of the General Medical Council—The Acting Secretary, British Pharmacopœia Commission, General Medical Council, 44 Hallam Street, W 1 A junior professional assistant in the Meteorological Office —The Secretary (S 1), Air Ministry, Adastral House Kingsway, W C 2 An assistant physicist in the experimental department of the Fine Cotton Spinners' and Doublers' Association, Ltd —The Chief of the Experimental Department of the Association, Rock Bank, Bollington near Macclesfield A physicist for research work in the laboratories of the British Boot, Shoe, and Allied Trades Research Association—The Secretary of the Association 19 Bedford Square, W C 1

Our Astronomical Column

FORBES'S COMET —The following observations of this comet were obtained by Dr H E Wood at the Union Observatory, Johannesburg

	U T	R A 1928 0	S Decl 1928 0
Nov	21 07734	12^h 8^m $29\ 31^s$	21° 43 44 5″
	26 07167	12 22 3 48	25 12 47 4
	30 07286	12 32 45 00	27 38 48 3
Dec	1 06356	12 35 22 30	28 12 20 4

Using these in combination with positions obtained at Algiers, Lick, and Yerkes Observatories, Dr A C D Crommelin has deduced the following elliptical elements

$$\begin{array}{ll} T & 1928 \text{ Nov } 5\ 02378 \text{ U T} \\ \omega & 196°\ 0'\ 13\ 6'' \\ \Omega & 250\ \ 5\ 19\ 1 \\ i & 28\ 54\ 6\ 1 \\ \phi & 67\ 48\ 54\ 2 \\ \log q & 9\ 8723448 \\ \text{Period} & 31\ 9448 \text{ years} \end{array} \left.\begin{array}{l} \\ \\ \\ \end{array}\right\} 1928\ 0$$

The identity with comets 1818 I (Pons) and 1873 VII (Coggia Winnecke) may now be looked on as established The identity of these two was already considered probable by Weiss and Schulhof, but the observed arcs in 1818 and 1873 were only 4 and 5 days so the matter remained conjectural The fact that the period found is much closer to 27½ than to 55 years makes it likely that the comet has made four revolutions since 1818, which would give a mean period of 27 69 years If this is correct, then the comet 1457 I (observed by Toscanelli and also in China) is probably the same comet, there being thirteen revolutions between 1457 and 1818, with a mean duration of each of 27 77 years The following are the elements of this comet, necessarily somewhat uncertain owing to the want of precision of observations at that date

$$T\ 1457 \text{ Jan } 18\ 0,\quad \omega\ 194\ 9° \quad \Omega\ 249\ 7°,$$
$$i\ 13\ 3°, \log q\ 9\ 847$$

The discoverer of the comet at this apparition is Mr A F J Forbes, of Rosebank, Cape Town, who is an architect by profession, and treasurer and librarian of the Cape centre of the Astronomical Society of South Africa He has been engaged for some months in sweeping for comets, using an 8 inch reflector which he constructed himself

The comet is now in south declination 42°, so it is out of reach of most northern observatories It is to be hoped that it will be observed over a sufficiently long arc to determine the elements, especially the period, with great precision

ARGON IN THE SOLAR CORONA —In NATURE for Feb 4, 1928, a letter by L M Freeman appeared, stating that a number of hitherto unidentified lines in the coronal spectrum had been attributed to argon, and promising further details in a forthcoming paper This paper has now appeared in the *Astrophysical Journal*, vol 68, p 177 The investigation of argon was suggested by the fact that three recurring differences of wave number between pairs of coronal lines agreed with the three chief term differences in the argon spectrum as investigated by Meissner Twenty two unknown lines of the corona are attributed with great plausibility to well known argon lines, while combination lines of argon account for a further ten Transitions from metastable states are not involved in these identifications, which is in accord with Eddington's theories A possible test of these results lies in the fact that two different combinations give a line very close to the bright green coronal line, the separation being about 0 1 A, so that it should be possible at future eclipses to detect the doublet structure of this line

Research Items

Excavations at Kish.—Reports on the work of the various archæological expeditions in the field at the opening of the new season are now beginning to come to hand. Among the more interesting of these is Prof. Langdon's letter to the *Times* of Jan. 4, which deals with the work of the University of Oxford Expedition at Kish, which resumed work in November. The first undertaking was to continue the attempt to secure an accurate and complete series of archæological stratifications, which last year had reached modern water level. This has now been carried farther by hydraulic methods down to virgin soil through three metres of wet earth. A scientific classification of the various periods from the beginning of civilisation to the neo-Babylonian period has thus been established. The cavity extends to 14 metres below the pavement of the temple of Nabunidus, dating to the end of the sixth century. The water level has risen nine feet since the foundation of Kish. The lowest stratum, now below water level, shows the monochrome and polychrome painted ware and the deep red ware with some fine black ware and beautifully made incised black pottery. The first two classes correspond to that found at Jemdet Nasr, 17 miles to the north-east, which has been dated at 3500 B.C. According to Prof. Langdon, it is clear that the proto-Sumerian people, who are the real founders of Kish and the proto-Sumerian cities of Mesopotamia, are really Elamites, and from the evidence now being obtained the foundation of these cities should be placed before 4000 B.C. Seven stages of human history are to be observed in the stratification now laid bare at Kish.

Birds and Environment.—An intensive study of the vertebrate fauna of a small area adjacent to the Missouri River in Kansas, has enabled Jean M. Linsdale to reach some general conclusions regarding the relationship of birds to their environment (*Wilson Bulletin*, September 1928). She discusses the dangers to which birds in the area are subjected, the influence of culture upon birds, and of birds upon culture, seasonal responses, relationship between species, and the changes which result from alteration in the environment. The interrelationships of the birds themselves are sketched in brief, and apart from these it is apparent that at almost every point a weighty factor is the presence of man, whether his interference be directly for or against the birds, or be reflected indirectly in changes in the avifauna due to the spread of civilisation and consequent changes in the character of the country-side. Her conclusions, which are similar to those reached by Ritchie in his study of the Scottish fauna, are, finally, that "the area under discussion probably has a larger bird population than it had when it was entirely in primitive conditions. A few large and conspicuous species are extinct, but many more are found now that were probably not present when the country was settled." It is difficult to reconcile this conclusion with the one prophecy made by the author: "with a greater utility of waste land and other resources, a point may finally be reached when the effect of man's work in this vicinity will be to eliminate nearly all the bird species." Surely this is in direct contradiction with the observed premises, unless it be foreseen that the whole area is to be built over?

Origin of the Fauna of the West Indies.—The origin of the West Indian fauna has been a subject of controversy, the alternative views being that the fauna has been derived from the mainland by migration over one-time land bridges, or that the fauna is a chance assemblage which has found its way thither by different methods across the existing seas. Karl Patterson Schmidt, in discussing the "Amphibians and Land Reptiles of Porto Rico," in a detailed monograph, comes down upon both sides of the fence (New York Academy of Sciences: Scientific Survey of Porto Rico and the Virgin Islands, vol. 10, Pt. 1, 1928). He considers that the Greater Antilles received their fauna from Central America probably in Eocene or even pre-Tertiary times and that the uniformity of the faunas of the larger islands suggests that these were united for a time. On the other hand he thinks that the Lesser Antillean fauna is derived from South America, that it is a genuinely fortuitous one, and that no land bridge has existed through this chain in Tertiary times. The Porto Rico fauna in particular is simply an impoverished Greater Antillean fauna, and its peculiar characters are due to a process of extinction still continuing, to the isolated position of Porto Rico at the eastern end of the land mass, and to the differentiation of the Porto Rican forms, partly through isolation during post-Pliocene times, and partly to the influence of the mountains of Porto Rico as a centre of differentiation throughout Tertiary times, before island conditions began.

Yolk Absorption in a Squid.—Dr. A. Portmann and Miss A. M. Bidder (*Quart. Jour. Micr. Sci.*, Oct. 1928) describe observations on yolk absorption in the squid *Loligo*. The yolk, large in amount, is contained in a closed yolk sac which has no communication with any other organ of the body. The sac is divided, like an hour-glass, into an external and internal part, both almost surrounded by blood spaces, and there is a blood circulation between the embryo and the external yolk sac by which nutritive material is transferred from the sac to the organs of the body. Growth of the arm musculature cuts off the circulation to the external yolk sac, and at this time the yolk is passed from the outer to the inner sac by regular contractions of circum-oral muscles, so that the internal yolk sac occupies almost the whole of the body cavity. During these changes the vitelline membrane of the internal yolk sac, hitherto extremely thin, thickens rapidly, and apparently is actively concerned in the transformation of the yolk. The increase in size of the internal yolk sac gradually brings the vitelline membrane into close relations with the liver and causes the suppression of the intervening blood sinus (except at the posterior end of the yolk sac), which for a time has transferred nutritive material from the yolk sac to the organs. The part of the vitelline membrane in contact with the liver is different from the rest, and here transformed yolk passes into the liver. Absorption of the yolk results in decrease of the internal yolk sac, which finally is almost surrounded by liver. During this stage the liver has rapidly increased in size, and that part in contact with the active vitelline membrane is clearly different from the rest; and the authors suggest the liver is performing two functions,—that common to the whole organ, as in the adult liver, and another—confined to the cells in contact with the yolk sac—the transformation of the yolk. They suggest that the transformed yolk, mixed with the digestive secretion of the liver, passes to the pancreas, where it is absorbed into the blood stream.

Nomenclature of Genes.—Breeding work with the domestic fowl at the Anikovo Genetic Station, near

Moscow, of which N K Koltzoff is director, led to the publication in 1926 of an extensive monograph in Russian with an English summary, on the genetics of fowls, written by Serebrovsky, Shivago, and others The results of this work are abstracted by Dr L C Dunn in *Jour Hered*, vol 19, No 11 The work aims at an analysis of the different breeds of hens in terms of their genes Particular chapters are devoted to inheritance of the size of the red blood corpuscles and the catalase content, the genetics of growth and size, and of egg laying Another is concerned with the chromosome complexes In this work, Serebrovsky introduces a new system of symbols (first proposed in 1921) which aims at producing an international method of naming genes, by which the same symbols will be used for the different groups of animals and also for plants The scheme is to subject every gene to a decimal system of classification, by which it receives a number based on its most characteristic phenotypic character Genes are first divided into ten classes according to whether they are histological, physiological, colour characters, etc These are each divided into ten groups, such as intensifiers, inhibitors, modifiers, etc The numbers so obtained are translated into letters according to an arbitrary table, so that a pronounceable word of four or five letters will result Thus *tifa* refers to the gene for melanin pigment, and *trage* to the barring factor When the same system of naming is applied to other groups, such as mammals or flowering plants, difficulties may arise, but there is certainly much need for uniformity in the nomenclature of each group

FORESTRY IN SWEDEN —In view of the importance of the world's resources of soft timber and the tendency for the supplies to decrease, it is of interest to note that in an address on forestry in Sweden printed in the *Journal of the Royal Society of Arts* for Dec 7, Prof E P Stebbing stated that the annual cut does not exceed the increment in that country although fifteen to twenty per cent of the areas felled annually are reforested by direct sowing or planting the remainder are naturally regenerated At the same time, he pointed out that while timber cutting on a large scale is in the forests favourably situated for access and transport, the increment is in young woods which will not be available for timber for many years In the interior of Norrland and in Svealand, the exploitation of mature and over mature timber exceeds the increment In southern Sweden there is a shortage of older timber, but young forest is much in evidence Considerable progress is being made in reclaiming marsh, heath, and bog for forest land This is done mainly by the State and the large timber companies but small proprietors are following the example thus set More than three thousand miles of forest drains were cut throughout the country in 1925, which gives some idea of the scale on which the problems of the forest lands is being faced Other aspects of Prof Stebbing's paper are of value in application to the forest lands of Great Britain

EXPERIMENTS IN MOUNTAIN BUILDING —The problem of *échelon* folds and the closely related phenomena of accurate folded mountains have been investigated by T A Link in a series of experiments carried out in the geophysical laboratories of the University of Chicago (*Jour Geol*, pp 526 538, 1928) It was found that differential stress transmission in the horizontal plane, through rigid materials bordering incompetent beds, gave rise to *en échelon* folds and arcuate systems, even though non rotational compression was applied The same effects were produced in homogeneous materials by applying rotational compression That is to say, differential stress transmission in geological formations may result from lateral variation in plasticity, rigidity, or competency in general It is shown that some of the experiments gave results comparable in tectonic structure with that of the Jura mountains The latter are interpreted as an arcuate system in relatively incompetent beds bordering the outer edge of the competent Nägelfluh conglomerate through which the stresses from the Alps were transmitted

ORE DEPOSITS OF JAPAN —For many years Prof Takeo Kato, of the Tokyo Imperial University, has been occupied with an intensive study of the late Tertiary vulcanism and associated ore deposits of Japan He has usefully summarised the results of these researches in a contribution to the *Jap Jour Geol and Geog*, 1928 Volcanic activity is represented by the characteristic succession (1) Rhyolite and associated tuffs, (2) pyroxene andesite and associated tuffs, (3) minor intrusive dykes of andesite, porphyrite, etc Mineralisation took place repeatedly in (1) and (2), and the ores are generally, though not always, cut by (3) Certain basalt dykes cut the whole series and are of the post Tertiary age The late Tertiary rocks are regarded as the derivatives of a parent magma cooling under plutonic conditions at a comparatively shallow depth, the mineralising solutions being the residual liquors expelled during a late stage of solidification The volcanic rocks and the ores are thus consanguineous, the parent of each being concealed in the depths, except locally, where crustal disturbances and erosion have been unusually active

SEMINOLE OILFIELD, OKLAHOMA —This oilfield, one of the greatest the world has ever known, has attracted attention not only on account of a prodigious production—200,000,000 barrels to the end of June 1928—but also for many important technical reasons Recent developments prove that no less than five separate oil pools occur in this field, known as Seabright, Seminole City, Bowlegs, Little River, and Earlsboro A geological feature of note is that the main producing horizon, the Wilcox Sand, is of Ordovician age, not younger Palæozoic, the case with the majority of oil fields in the Mid Continent region Some production is also obtained from the Hunter Lime, of Silurian Devonian age, principally in the Seabright unit The Wilcox Sand lies at depths ranging from 4000 ft to 4300 ft, according to well location, it yields an oil of gravity varying between 0 814 and 0 840 Drilling and production technique in this field have recently been described by Mr G Heseldin to the Institution of Petroleum Technologists, and, as might be anticipated, provided much interesting data, having regard particularly to the size of the pools, rock conditions, oil and gas pressures, and general rapidity of development Much of the drilling is by rotary drill down to depths of 3700 3800 ft, when $8\frac{1}{4}$ inch casing is set and drilling continued with cable tools, this being practicable owing to the comparatively low pressure of the oil in the sand Some idea of the intensity of development can be gleaned from an example of one well quoted by the author this took four days to complete the rig, five days later drilling commenced, in less than fifteen weeks drilling was completed to 4485 ft, 4100 ft of this being made in 50 days The drillers work in what are known as 'twelve hour towers' and for seven days per week The greatest footage made in one 'tower' was 220 feet

SUPERCONDUCTIVITY —The September issue of the *Journal de Physique* contains the address on this subject which Prof de Haas, of Leyden, gave to the French Physical Society in May last When a metal

such as mercury has its temperature reduced, its electrical conductivity increases in the usual way until the temperature is within a few degrees of the absolute zero—4 2° absolute in the case of mercury—when the conductivity becomes very large Without any change of temperature, the conductivity may be reduced by the application of a magnetic field in the direction of the current, and on withdrawal of the field the metal becomes again a superconductor If the field be withdrawn gradually, the superconductiv ity is acquired in steps, and the steps occur at different fields in different parts of the conductor The author ascribes this to the formation of filaments of atoms along which the electrons move freely, and not to the presence of free electrons in the spaces between the atoms Superconductivity is brought about by the facility with which the 2, 3, or 4 electrons of the outer layer of an atom can pass from atom to atom when the irregular movements due to temperature have been reduced

LIGHTNING AND OVERHEAD ELECTRIC POWER LINES —The high pressure overhead systems which electricians are now using to convey electric power from their generating stations to their distributing stations have to be protected against the effects of lightning strokes by safety devices In the *Westing house International Journal* for January, E Beck describes the methods being adopted and the apparatus used by the Westinghouse Company to find out the exact nature of the disturbance caused by a lightning flash in the immediate neighbourhood of an overhead high pressure power system The experiments are being made in the Smoky Mountains of Tennessee, U S A A special research staff is employed and elaborate instruments are used The disturbance of the voltage of the overhead system when a flash occurs acts on a Dufour cathode ray oscillograph and a photograph of the transient disturbance is obtained Radio receiving sets and a special form of relay which rings a bell are used for signalling the approach of a storm The photographic film moves with a velocity of 12,000 feet per minute It is found, however, that this is only suitable for the measurement of slow lightning transients In order to get a record of the more rapid effects, a rapid oscillatory motion is given to the electron beam Another instrument used to locate the position of the stroke is called the 'osiso' It is used to measure accurately the time between the beginning of the oscillograph transient and the arrival of the noise of the thunder as recorded on a film Two of these instruments enable the accurate position of the stroke to be found by triangulation A special form of camera is also used, which enables a photograph of the entire horizon to be obtained It is hoped in this way to find out the connexion between lightning strokes and the ensuing disturbances on overhead systems

CIRCUIT BREAKING WITH HEAVY CURRENTS - The difficulties that have been experienced in switching off very large electric currents in circuits which contain an appreciable amount of inductance have led manu facturers to make many careful experimental re searches on the subject Since 1922 the British Electrical Research Association has been experiment ing on 'circuit breaking' with special reference to the rupture of the arc A paper giving an introduction to these researches, by E B Wedmore, W B Whitney, and C E R Bruce, was read to the Institution of Electrical Engineers on Dec 20 The experiments were carried out at the Carville power station at New castle Three special cases were considered when the separating contact pieces were immersed in oil In the first case, the arc goes out in a bubble of gas separ ating the contacts In the second case both oil and gas are present together, and in the third case the whole path is filled with oil The last case is an ex ceedingly rare occurrence, and the second case presents great difficulties, as it is almost impossible to deter mine the relative amounts of oil and gas present in the path of the arc Hydrogen is the principal constituent of the gases produced by arcing in oil It was found that a relatively large proportion of acetylene was produced—in some cases it was as large as 30 per cent This is much larger than that found by previous in vestigators, due possibly to neglect of the fact that acetylene is soluble in water The breaking of an alternating current circuit simplifies the problem of how to prevent the arc restarting once the current has attained zero value Some interference with the arc is necessary during the flow of current Merely to increase the speed of separation of the contact pieces or to use magnetic 'blow outs' is not necessarily a satisfactory solution It has been shown to be possible to rupture arcs in air, the current in which is approxi mately 7000 amperes in value and the potential differ ence across which is 5500 volts, with a single air gap only ⅜ inch in length

IGNITION OF FIREDAMP —The Safety in Mines Research Board has just issued *Paper* No 46 on the ignition of firedamp by the heat of impact of rocks, written by M J Burgess and R V Wheeler The subject is an important one, because there are a number of examples on record in which the heat or the sparks evolved by falling rocks appeared to be the only possible explanation of certain mysterious colliery explosions The difficulty has been that hitherto there has been no definite proof that firedamp could be ignited in this way That proof is supplied in the present paper, in which experiments are described in which a block of siliceous rock was pressed against a revolving wheel made of the same rock, and it was found that ignitions of firedamp could be produced comparatively easily under these conditions and that weak mixtures of methane and air could be ignited more easily than rich mixtures It was shown that an expenditure of energy of less than 200 ft lb was suf ficient in some cases to produce ignition, and that a duration of contact between the rock surfaces of between ⅜ths and ⅝ths of a second was sufficient for ignition The paper is a record of a very valuable piece of work, which will no doubt tend to throw light upon one of the possible causes of colliery ex plosions

NEW METHOD FOR MEASURING OSMOTIC PRESSURE —The experimental study of osmotic pressure is a matter of considerable difficulty Apart from its importance in biology, a convenient method of measuring osmotic pressure would be of great value in the investigation of dilute solutions, and hence it is interesting to note that a new method is described by R V Townend in the *Journal of the American Chemical Society* for November It can be applied to any non volatile solute in a volatile solvent, the solution and pure solvent being separated by the vapour phase, which acts as a diaphragm permeable to solvent molecules only The pure solvent is located within the capillaries of a porous plate and the liquid at the surface of the plate is placed under a tension so that the normal curvature is altered and the vapour pressure reduced The rates of distillation from solvent to solution are measured under different tensions, and the osmotic pressure, *i e* the tension for zero distillation, is obtained by extrapolation of the resulting curve

Annual Exhibition of the Physical and Optical Societies

THE Imperial College of Science and Technology, London, was once more the scene of the annual exhibition (the nineteenth) of the Physical and Optical Societies on Jan 8 9, and 10 The large number of visitors again testified to the widespread interest in the Exhibition on all sides, and its usefulness to trade and industry was evident by the exhibits, bewildering in their number and variety, of the various sections The general arrangements were similar to those of last year, and congratulations must once more be offered to Mr T Martin as secretary, on the success which attended the Exhibition and to all those responsible in various ways for their unfailing courtesy and helpfulness

It is impossible in a short description to do justice to every part of the Exhibition, and the only plan that can be followed, therefore is to mention, so far as possible, some of the exhibits typical of recent developments in research and industry

In the Trade Section there were eighty two exhibiting firms Among their exhibits the following may be mentioned Messrs Baird and Tatlock, Ltd, the Sutton photometer bench and a pump with double acting pistons for aerating aquaria tanks, etc, its special attributes being its silent action and economy in use Bakelite, Ltd, a new flaked fabric moulding material, particularly resistant to shock The British Metallising Company, Ltd, had an exhibit illustrating the present and possible uses to scientific instrument manufacturers of their process of producing a metal film or coating firmly adherent to a non metallic base, on which in turn a large range of non ferrous metals may afterwards be plated to any desired thickness The Cambridge Instrument Company, Ltd, the Campbell A C Potentiometer (Larsen type), a modified form of the photoelectric microphotometer originally developed by Dr G M B Dobson, a new portable form of electrocardiograph, and other novelties The Edison Swan Electric Company, Ltd various Ediswan battery eliminating devices for wireless receivers and other devices for wireless outfits, and a gas filled rectifier for heavy currents for charging car batteries The Foster Instrument Company the intrascope, a new instrument for internal examination of tubes, bores, and other enclosures in which by means of a novel optical system, examination of industrial structures can be made in the same way as with the cystoscope on the human body The Research Laboratories of the Gramophone Company Ltd a logarithmic recording galvanometer, by means of which the electrical response curve characteristic of a gramophone pick up can be obtained photographically and plotted automatically with a logarithmic scale a demonstration of the vibrations of a membrane type loud speaker by means of lycopodium powder aroused much interest Messrs Hilger, Ltd, Dr Jean Thibaud's grating spectrograph for the study of soft X rays and of the extreme ultra violet, in which the ruled grating is so placed that the incident rays fall almost tangentially upon its surface, some samples of pure earths—spectroscopically standardised substances The Igranic Electric Company Ltd, the transverse current microphone, the Phonovox electrical reproducing equipment Messrs E Leitz, London, a new pattern ultra microscope for the investigation of elements in colloids Marconi's Wireless Telegraph Company Ltd, a signal strength measuring set with a wave range of 14 5000 metres, a tuning fork and thermostat unit for maintaining constant frequency in facsimile transmission The M L Magneto Syndicate, Ltd, Coventry, the M L noise comparator—an instrument designed to give a quantitative measure for noises in industrial mechanism, a direct reading apparatus which requires no aural observation, and can be operated by an unskilled observer The National Glass Industry, Dewar's flasks for liquid air, etc and various experimental glassware Negretti and Zambra, a new industrial type of ventilated hygrometer, a new recording rain gauge to overcome the difficulties of the self syphoning type Siemens Brothers and Co Ltd, distance thermometers of various types, the substantial construction of these being of particular note H Tinsley and Company, a portable electric harmoniser under the patent of Prof Miles Walker Messrs Beck, various new microscopes, including the No 22 metallurgical microscope Messrs Carl Zeiss London, Ltd, a hand sugar refractometer, and refractometer for the oil and sugar industries Messrs Bellingham and Stanley, Ltd, showed a new model critical angle refractometer, quartz spectrographs, etc

In the Research and Experimental Section there were sixteen groups of exhibits illustrating recent physical research The Brown Firth Research Laboratories had an interesting demonstration of dyed fabrics, showing in a striking manner the different tints of colour obtained when using container vessels of enamelled iron (taken as standard), copper, iron, nickel lead, and Firth 'staybrite' steel Among other examples of the applications of photoelectric cells the Research Laboratories of the General Electric Company showed an apparatus for the detection of dust or smoke in air or gases The National Physical Laboratory supplied eleven exhibits among which may be mentioned Dr D W Dye's interferometer for the examination of the modes of vibration of piezo electric quartz plates, by means of this apparatus the interference fringes are disturbed by the vibration of the quartz plates and the whole area can be mapped into its nodal and antinodal parts, and a beat tone oscillator as a low and telephonic frequency source of good wave form and constant output for testing purposes, a high temperature resistance furnace and electric radiator by Dr W Rosenhain and Mr W E Prytherch, in which the heater elements are of particular note, a method of measuring flame temperature by spectrum reversal by Dr Ezer Griffiths and Mr J H Awbery The Air Ministry Section of the Meteorological Office had five exhibits, including a sky photometer and an electrical wind direction recorder Prof E W Scripture of Vienna showed a graphic apparatus for the registration of speech and the strobilion, an apparatus for rendering the frequency of the voice tone visible Dr J H Vincent showed some experiments in magnetostrictive oscillations at audio and radio frequencies

In the section devoted to lecture and instructional experiments in physics, Mr S R Humby gave some beautiful demonstrations of experiments by means of a modified Tyndall apparatus, showing that the laws of reflection of light hold accurately for sound—illustrating Lloyd's single mirror fringes, Lippmann's stationary light waves and other effects Messrs W and T Avery, Ltd, Research Department, had a number of exhibits illustrating the mechanics of the freely suspended beam and of linked weighing mechanisms Other exhibitors in this section were Mr J E Calthrop, Dr R S Clay, Mr C W Hansell, Dr L F Richardson and others of Westminster Training College, Dr G D West, and the Physics Department of the Wigan and District Mining and Technical College

The Historical Section again provided an oppor-

tunity for a survey of past development in science, all the more striking for being placed near the exhibits of such modern developments as those of the Igranic and Gramophone and other companies The exhibits included some examples of scientific instruments to illustrate the work of a series of London instrument makers in direct succession from Christopher Cock (seventeenth century) to Elliott (nineteenth century), contributed by Mr T H Court, among which may be noted Robert Hooke's own microscope, photographs of the original apparatus used by Alessandro Volta in his researches of 1763–1819, exhibited by Mr Robert W Paul, and some early and primitive time measuring devices contributed by the Science Museum, from early Egyptian water clocks to a seventeenth century turret clock from St Giles' Church Cambridge

The discourses once more attracted keenly interested audiences, whose appreciation was obvious That on the first evening was delivered by Prof F Lloyd Hopwood, whose subject was "Experiments with High Frequency Sound Waves" He made use of a quartz piezo electric oscillator, the crystals being cut in the form of circular discs with their plane faces parallel to the optical axis and at right angles to an electric or binary axis This method of producing vibrations is due to Prof Langevin, of Paris, and many practical applications of it have been made both in peace and war The quartz discs were immersed in transformer oil contained in glass tanks, suitable arrangements being made for producing both horizontal and vertical beams of sound The method used in connexion with a horizontal beam was due to Prof R W Boyle, and exemplified stationary waves (obtained by reflection and rendered visible by the striæ formed in dust lying on a horizontal sheet of glass in the path of the beam), interference patterns, diffraction effects, attenuation (observed by bringing into action the frictional dissipation of energy due to the viscosity of the oil vibrating in a confined space, achieved quite simply by supporting a second glass plate almost in contact with the fir s, pressure of sound radiation, shown by means o Langevin's acoustic radiometer Some biological effects brought about by the agency of ultra sonic sound waves were then described and illustrated by means of slides—a beautiful example being the segregating of the chloroplasts in the fresh water plant *Nitella* By making use of a vertical beam of ultra sonic waves some experiments were shown illustrating phenomena not usually associated with sound These depend on the effect of pressure due to radiation on the surface of oil, which is strikingly shown by the formation of a mound of oil which erupts drops like a miniature volcano By plunging vessels of appropriate form into this mound, vibrations of great intensity are communicated to the walls of the vessel or through the walls to liquids contained in them By these means it is possible to show cavitation in water, the vaporisation of benzene transverse vibrations of a solid by the pattern produced in a test tube dusted with lycopodium powder, and the calorific effect by melting a wax ball, which can be made to simulate the descent of a time ball

On the second evening, Mr Conrad Beck discoursed on "Lenses" The Greeks, he said, at least as early as 430 B C, learnt that a piece of glass with curved surfaces could be used as a burning glass, and the derivation of the word 'focus' is from the word meaning 'altar' or place of fire Text books treat the focus as a geometric point formed by light entering the lens as a parallel beam This is incorrect and leads to misconception The focus of the ancients was a finite spot and not a point Mr Beck said that the way to understand the action of a lens is to study how it produces an image, for which three processes are necessary the production of an image of a spot in the centre of the object on the axis, the direction of the axial rays from spots on the object away from the axis, and the examination of a complete bundle of rays from the marginal spot on the object The Galilean field glass, telescopes, periscopes photo graphic and projecting lenses were discussed, and the study of the Gauss theory for the invention of new and original types of instruments was advocated Mr Beck considers that great attention should be paid to the more elementary principles of image formation before the questions of the correction of aberrations or the considerations of diffraction are investigated

The lecture on the third evening, entitled "Some Colour Problems in Photo Engraving," was given by Mr A J Bull and dealt with the effects in three colour printing of errors in the selective absorption of the three colour 'filters' and printing inks Experiments were shown in which white light was imitated by superposing the colours transmitted by three colour 'filters' and it was shown that to obtain a white a larger area of blue filter is required than green, and a larger area of green filter than red—blue green, red being the order of their increasing transparency The colours obtainable are, however, fairly pure and close to theoretical requirements, so that screen plate processes give colour photographs which are fairly accurate as to colour but much lower in tone This was shown by examples with the Lumière Autochrome plate The ideal double colours which are desirable for the purposes of printing were shown by optical superposition of red and green images to obtain a yellow printing colour, green and blue images to obtain a 'blue' printing colour, and blue and red images to obtain a magenta or 'red' printing colour These were contrasted with the colours of inks actually obtainable and the inaccuracies introduced were shown These take the form of darkening blues and greens and a loss of reflected blue light with purples and pinks The methods used for retouching were indicated, in half tone work the skill of the colour etchers is such that excellent colour prints can be obtained by them from monochrome originals

KATHLEEN E BINGHAM

Annual Conference of the Geographical Association

THE annual conference of the Geographical Association was held at the London School of Economics on Jan 3–5 In addition to the usual business meetings, and some discussions on special problems of the teaching of geography, there were public lectures on some recent research work, and the chief part of the presidential address was also concerned with geographical investigation The president, Sir H G Lyons, gave a concise review of the year's activities and then indicated the vast mass of material now available for geographical study in the reports and maps of the many national and other surveys now at work, and some of the difficulties of access to this material He suggested that the Association should seek the co operation of other interested societies in attempts to obtain some satisfactory classification of, and readier access to, this material

Of the four main papers,[1] three dealt with human

[1] Geomorphological Problems of the Eastern Alps, by Prof J Sölch Natural Environment related to Human Activity in the Corn Belt of North America, by Dr P W Bryan, The Balance of Urban and Rural Populations by Prof C B Fawcett On Linguistic Frontiers in the Borderlands of German Speech by Dr Vaughan Cornish

geography and only one with a purely physical problem This is a reversal of the proportions which held good in most geographical work even a few years ago, and it marks the extent to which geographers are now attempting to investigate their central problem of the relations of man to his environment and his modifications of the natural environment Dr Bryan gave a vivid account of the cultural landscape of rural central Illinois as it is to day, after more than half a century's work by a population of skilled agriculturists, under favourable physical, political, and economic conditions, has made that area the heart of the Corn Belt Here the first settlers, coming from the wooded regions of Western Europe or the Eastern States, chose the forested bottom lands as the most fertile and left the treeless prairie untouched, though their choice was also influenced by the fact that they were dependent on the rivers for bulk transport in the pre railway period But the soils of the open prairies, fertilised by the humus accumulated from the annual sod of many centuries and retaining their fertility better than the soils of steeper slopes and wetter bottoms, where also tree growth gave a less quantity of humus, are better than any of the other soils except annually renewed river alluvium, and so the prairies are now the richer farmland The corn belt is by no means a one-crop area, like so much of the cotton belt and some newer parts of the wheat region to the north west The corn (maize) is usually grown for two years of a four year rotation on the best soils and one year in three on other soils The specialisation of farms in the use of the corn for sale as grain, or for feeding dairy or beef cattle, or swine, is determined mainly by the relative transport facilities for the more or less rapid disposal of their produce by rail to the cities

A contrast to this account of a modern adjustment to a particular type of environment was furnished by Dr Cornish's study of the borders of German speech The author's thesis was that these borders were, for the most part, fixed at the time when Christianity was adopted by, or imposed on, the several peoples concerned, that the Church estimated carefully, and usually accurately, the territorial limits of the languages in use by its converts, and adapted its organisation of bishoprics and archiepiscopal provinces to those limits, and further, that through this organisation the Church did much to stabilise the boundaries which it had adopted and the languages which it recognised and helped to develop Thus, on the whole, the boundaries established from the fifth century (in the west) to the thirteenth century (in the north east) remain to day The thesis was illustrated by detailed studies of the linguistic borders in Belgium, Alsace Lorraine, Switzerland, Tirol, Carinthia, Bohemia, Poland, and Slesvig

The third paper, by Prof C B Fawcett, was an examination of a particular problem of the distribution of population The differences of classification in various censuses make it impossible to obtain close and trustworthy comparisons of the proportions of urban and rural populations in many countries According to such census returns, the urban population ranges from 10 per cent of the total in India to 79 per cent in England, and from 3 per cent in Assam to more than 90 per cent in the southern states of New England Such numerical comparisons are only possible for part of the last century and for the more advanced countries The maximum numbers of the urban population are fixed by the surplus food produced by the rural population, in any self contained region and in the world as a whole, and the possibility of transporting that food to the towns As a result of the improvement of the tools and technique of agriculture, and of transport, during the last two centuries the urban population is now more than half of the total in most of the lands of western civilisation These improvements act in two ways, first by reducing the number of workers required to cultivate a given quantity of any crop, and second by enabling almost all the industries other than agriculture to be concentrated in the towns A study of the numbers of the agricultural workers and the proportions of home-grown foods in Great Britain led to the estimate that under the conditions of this country the rural population, not including therein urban workers resident in rural districts, should number at least 25 per cent of the whole population to make the country self supporting in regard to its principal foodstuffs

Prof Sölch's lecture was accompanied by a number of magnificent photographs of Alpine scenery illustrating the existence of several comparatively plane, though much dissected, surfaces, which he termed 'flats,' at various altitudes in the Alps He compared these with similar land forms in the British highlands, and appealed for comparative studies and co operation in the task of investigating the ages of these 'flats' and their relations to different stages in the uplift of the Alps and to glacial and interglacial periods

These papers will probably be published in full in early numbers of *Geography*, the magazine of the Geographical Association, which is to be issued as a quarterly from now on

University and Educational Intelligence

APPLICATIONS are invited by the committee of the Royal Society and the University of Sheffield appointed to administer the Sorby Research Fund, for the Sorby research fellowship, value £500 per annum and tenable for five years Particulars may be obtained from the Assistant Secretary of the Royal Society, Burlington House, London, W 1

IN the recent Report of the National Fuel and Power Committee it was stated that the most economic use of fuels is largely dependent on a highly trained personnel With this in mind, the Governors of the Sir John Cass Technical Institute, Aldgate, E C 3, are extending their existing courses in fuel technology by an advanced and post graduate course on "Coal Carbonisation," and the inaugural lecture will be delivered by Dr F S Sinnatt, of the Fuel Research Board, on Jan 28 at 7 P M Admission to this lecture is free

NEGRO universities and colleges in the United States of America have six times as many students as they had ten years ago This very striking growth is one of the developments brought to light by a comprehensive survey of 79 institutions for the higher education of negroes recently completed by the United States Bureau of Education It means that the negro universities and colleges have been growing three times as fast as the others Their aggregate annual income increased in the same period nearly fourfold Even now, however, their students constitute only one sixtieth of the total number of university and college students in the United States, and their incomes amount to only one fiftieth of the aggregate incomes of all such institutions Although there has been a correspondingly rapid increase in the number of negroes entering the professions for which preparation can be had only in institutions for higher education, the number of negro doctors, dentists, architects, engineers, etc, is still wholly insufficient to provide all the professional service required by the negro population

Calendar of Patent Records

January 21, 1630—The first patent to contain a direct proposal to raise water by fire was granted in England to David Ramsey, one of the grooms of the Privy Chamber, on Jan 21, 1630 The patent recites a number of devices of which Ramsey claims to be the inventor, amongst which are to raise water from lowe pitts by fire, to make any sort of mills to go without the helpe of wind waite, or horse, to make boates shippes and barges to goe against strong winde and tyde, to rayse water from low places and mynes and coale pitts by a new waie never yet in use No record of the details of these inventions is however, available

January 23 1798—Chlorine was first suggested as a bleaching agent for cotton goods by the French chemist Berthollet, and was so used by James Watt and others, but the establishment of the industry is mainly due to Charles Tennant of Glasgow, who patented his process for absorbing the gas in lime on Jan 23, 1798 The patent was revoked four years later on the ground that Tennant was not the true inventor but a second patent granted to him in 1799 for the production of bleaching powder by impregnating slaked lime in the dry state with chlorine was more successful, and Tennant's works at St Rollox Glasgow, became the largest in the world

January 23, 1849—From the middle of the eighteenth century onwards many proposals were made for the coking and industrial utilisation of peat, but the first large peat distillation factory was started by the Irish Peat Company at Kilberry, Co Kildare Ireland, to work the process invented by Rees Reece, for which an English patent was granted to him on Jan 23, 1849 The process created great interest, and a Government Commission was appointed to investigate its possibilities, but the factory was compelled to close down a few years later

January 24, 1578 London was given its first water supply by Peter Morris who was granted a patent for 21 years for his engine for raising water, on Jan 24, 1578, and later obtained permission from the City Corporation to pump water from the Thames into the City by means of water wheels placed in the arches of London Bridge and driven by the tide The installation, completed in 1582, and enlarged from time to time by the addition of further water wheels, furnished the City with water for 240 years, and only came to an end with the demolition of the old bridge in 1822

January 24, 1730—An important event in the history of chocolate making was the patent granted to Walter Churchman of Bristol on Jan 24, 1730, for an invention described as a new invention and method for the expeditious, fine, and clean making of chocolate by an engine driven by a water wheel' The exact process was kept secret, but on Churchman s death the business was purchased by Joseph Fry, and thus became the starting point of the well known firm of J S Fry and Sons The water wheel was replaced by a Watt steam engine before 1798

January 26, 1796—E T Jones, accountant of Bristol, was granted a patent on Jan 26 1796, for his ' new invented speedy and effectual method or plan for detecting errors in accounts of all kinds, and whereby such accounts will be kept and adjusted in a much more regular and concise manner than by any other method hitherto known The patent would not presumably have stood the test of an action in the courts, but it no doubt served as an excellent advertisement for the pamphlet explaining his system, which Jones issued, with a licence to use it, at the price of one guinea

Societies and Academies

PARIS

Academy of Sciences, Dec 10—**Maurice Hamy** A consequence of a property of diffraction by a circular aperture—**Charles Moureu, Charles Dufraisse**, and **Marius Badoche** Autoxidation and antioxygen action (33) The catalytic properties of antimony, bismuth, and their derivatives, and of some vanadium derivatives The experimental results are summarised in eight diagrams The catalytic properties of vanadium compounds were very marked—**L Cayeux** The existence of fresh water spongoliths in the Gard coal basin The silex of Doulovy is composed of spongoliths, exceptionally rich in spicules, and proves the existence of fresh water sponges at a very remote period—**Gabriel Bertrand** and **Boje Benzon** The proportions of zinc in plants used for food The leaves of plants contain zinc in amounts which increase with the proportion of chlorophyll present Bulbs (garlic onion) and seeds contain the highest percentages of zinc—**Riquier** A problem relating to the partial differential equation $\left(\frac{\partial^2}{\partial x^2}+\frac{\partial^2}{\partial y^2}\right)^n u \quad f(x\ y)$—**Jean Baptiste Senderens** The catalytic dehydration of alcohols by alkaline bisulphates Several dehydrations hitherto carried out with potassium bisulphate can be effected with greater facility with sodium bisulphate Details of the preparation of cyclohexene from cyclohexanol are given—**Charles Nicolle Charles Anderson**, and **Jacques Colas Belcour** The experimental adaptation of recurrent spirochætes to species of *Ornithodora* other than those which transmit them in Nature The necessary conditions for success in these experiments are that nymphs must be used since although adults can be infected they are incapable (with rare exceptions) of transmitting the spirochætes by their bites, and to utilise for the infecting meal an animal the blood of which is rich in spirochætes—Serge Bernstein was elected *Correspondant* for the Section of Geometry—**Paul Delens** The calculus of spherical operations—**Marcel Vasseur** The deformation of a surface with a conical conjugated network—**Pierre Rivet** The contact of skew curves and of surfaces—**Mandelbrojt** A generalisation of a theorem of M Hadamard—**Florin Vasilesco** The nature of irregular and regular points and their distribution on the frontier of a domain—**Belzecki** Some cases of equilibrium of elasticity of a rectangular prism—**D Pompeiu** A formula generalising Cauchy s integral and its interpretation in hydrodynamics—**Henri Bénard** Alternate vortices and the law of dynamic similitude—**G P Arcay** The influence of vibrations on the rate of chronometers Vibrations bring about a change in the rate of the chronometer, usually a retardation and part of this change in rate is permanent The results of the experiments are given in detail—**Josef Mikuláš Mohr** The law of frequencies of the velocities of stars and the relation between the absolute magnitude and absolute velocity for *G* type stars The distribution of the frequencies of the absolute velocities of these stars, found by the author for 519 stars, is in agreement with the law of Adams, Strömberg and Jay, resulting from the study of type *K*—**R Jarry-Desloges** The period of the planet Venus The figure deduced is 23 hours 53 minutes, but this result is approximate only, since it implies no change in the markings on the planet during a terrestrial day—**E Pierret** Oscillators with very short waves—**G Grenet** The Hughes induction balance for the determination of the susceptibility of rocks By the use of the methods and apparatus of wireless telephony, the sensitiveness of the Hughes

induction balance can be increased to a marked extent The apparatus requires some tedious preliminary adjustments, but once set up, the determination of the magnetisation coefficient of a rock can be completed in five minutes —**Paul Soleillet** The theory of the polarisation of light emitted by fluorescence —**Mlle Jacqueline Zadoc-Kahn** The refractive indices of a mesomorphic substance in the solid state Details of the measurements of the three principal refractive indices of crystals of para azoxyanisol From the results, this is one of the most strongly doubly refractive substances known —**R Coustal** The permanent luminescence of certain crystallised salts of uranium Uranium salts have a faint permanent luminosity visible only after the eye of the observer has been in complete darkness for thirty minutes or longer The effect is shown most strongly by the sulphate the nitrate rather less acetate and other salts much less The explanation is based on energy derived from the radioactivity of the uranium —**Pierre Auger** The directions of emission of the photoelectrons —**A Boutaric and M Doladilhe** The electrosmosis of mixtures of electrolytes —**Pierre Jolibois and Pierre Montagne** A rapid method of calculation of homogeneous dissociations Application to carbon dioxide A graphical method is described and illustrated – **Lécorché and Jovinet** Study of the mechanism of the stabilisation of nitroglycerol powders by diethyldiphenylurea As soon as the powder becomes acid, the nitrous acid formed is absorbed, giving ethylphenylnitrosamine the latter can be readily determined by a colour method based on the reaction with α naphthylamine and hydrochloric acid —**Albert Portevin** The action of sulphur dioxide at high temperatures on glasses and basic rocks and a probable origin of sulphate mineral springs Sulphur dioxide, even when diluted with other gases, at high temperatures attacks basic rocks and glasses superficially, forming the sulphates of the alkalis and alkaline earths The attack is selective, as in spite of the low proportion of sodium in the rocks attacked, the deposit consists mainly of sodium sulphate —**J Fallot** The northern limit of the subbetic over thrusts between Sierra Sagra and Rio Segura —**Léon Moret** The extension of the strata containing *Hemithersitea* and phosphate in the southern slope of the Marrakech Atlas (Morocco) —**Aug Chevalier** The origin of the Imbuia wood (Brazilian walnut) of Brazil and the biology of the producing tree, *Phœbe porosa*, belonging to the Lauraceæ family —**Pierre Dangeard** The favourable action of potassium iodide on iodovolatilisation The emission of free iodine by certain algæ is increased by treatment with sea water containing a small proportion of potassium iodide in solution —**Paul Guérin** Hydrocyanic acid in lotus A discussion of the amount of hydrocyanic acid present in varieties of *Lotus*, with reference to possible danger as fodder —**Serge Yourievitch** The energetics of the ocular movements —**G Hamel and J Feldmann** The geographical distribution of the Fucaceæ and *Laminaria* on the western coasts of the Iberian peninsula —**A Magnan and A Sainte-Laguë** The experimental determination of the resistance to the forward motion of fishes The results of a kinematographic study giving true velocities —**S Posternak** A new organic phosphorus compound in the red blood corpuscles The new compound is probably a diphosphate of α ketotrioxyadipic acid —**Y Manouelian and J Viala** The spinal marrow, the bulb, the protuberance, and the parasite of hydrophobia —**Et Burnet, P Durand, and D Olmer** Marseilles exanthematic fever is absolutely distinct from exanthematic typhus fever The Marseilles fever does not give immunity against typhus (in the ape), and acquired immunity against typhus does not prevent the development of Marseilles fever, thus proving that the two diseases are distinct —**Camille Nachet** A new arrangement for the simultaneous registration of three selected images for the production of photographs in colour

GENEVA

Society of Physics and Natural History, Nov 8 —**Pierre Dive** The existence of a permanent regime of rotation in a heterogeneous fluid with ellipsoidal stratification The author completes as follows a proposition previously enunciated Whatever may be the law of variation of the flattening of the layers, there exists a permanent regime of rotation which maintains the fluid in its initial stratification except perhaps in two extreme cases Except for this, none of the earlier conclusions requires modification —**Rolin Wavre** The lines of force of the field of gravity Continuing his earlier work, the author deduces two new propositions (1) If in a portion of a fluid the surfaces of equal density are parallel they have also a mean constant curvature (2) If the tangent to a line of force of the field of gravity is stationary at a point, the mean curvature of the surface of equal density passing through this point is equally stationary there —**Fernand Chodat** The rôle of plants in the atmometric equilibrium of their phyllospheres New atmometric researches made at the Linnæus alpine garden show that each plant association creates for itself a specific atmosphere, the phyllosphere It is the same for each plant The author gives measurements which express the contribution of different plants in the phenomenon of inhibition of the transpiration of the soil by the herbaceous covering

Nov 22 —**A Berloz** The volumetric estimation of gold in electrolysis baths During electrolysis, the concentration of the bath diminishes and it is desirable to have a method of determination which is both rapid and of sufficient accuracy The author has adapted Jüpner's method (reduction of the gold in solution by a ferrous salt and titration of the excess of the latter with 0 5 normal permanganate) to the case of baths containing impurities, such as salts of bismuth, antimony, etc —**E Joukowsky** Some observations on the phreatic waters of the Genevan plateau The author has proved for two points of the same phreatic sheet, situated at a depth of about 25 metres, that the level of this sheet is always comprised between that of the lake and that of its outlet The curves traced during several months show that the precipitations have no influence on the level of the deep waters Variations in the level of the lake and previously of the outlet, on the contrary, are felt after a lag of several days —**Sw Posternak** A new organic phosphorus compound of the red blood corpuscles Pursuing his researches on the blood corpuscles of the horse, the author has been able to isolate in addition to the di and monophosphate of *l* glyceric acid, a new dextrorotatory principle, the diphosphate of α ketotrioxyadipic acid, reducing Fehling's solution This product is certainly related to hexose diphosphoric acid and probably represents an intermediate stage in the course of the elaboration of lactic acid in the muscle and in other tissues

SYDNEY

Royal Society of New South Wales, Sept 5 —**C A Sussmilch, W Clark, and W A Greig** Geology of Port Stephens The area dealt with is situated immediately to the south of Port Stephens The rocks occurring here belong to the Kuttung Series, a subdivision of the Carboniferous formation Much of the Kuttung Series throughout the area is hidden under a

mantle of recent alluvian and blown sand, but the outcrops which do occur consist mainly of igneous rocks (lava flows) These Kuttung lavas fall into three groups as follows (a) Andesites, (b) toscanites, and (c) rhyolites The andesites occur near the base of the series, and have associated with them coarse con glomerates, the toscanites form a very thick series of flows upwards of 1000 ft in thickness With the rhyolites is associated a thick series of sedimentary strata consisting mainly of tuffs and tuffaceous con glomerates, but containing also thin beds of cherty shales containing fossil plants (*Rhacopteris*, etc) These facts indicate that the district suffered from intense volcanic activity during the Carboniferous period —R H **Cambage** The outbreak of springs in autumn During drought times it is not uncommon to hear of the outbreak of springs in New South Wales between February and June, this has nothing to do with the droughty conditions, but is the result of diminishing evaporation These springs usually come from swamps, and often stop running during the hot weather owing to the whole of the moisture on the surface of the swamp being evaporated At Kosciusko there is a small roadside spring which regularly flows a distance of 252 yards during the afternoon while it is in shadow, and at night, but late in the forenoon, owing to evaporation while it is fully exposed to the sun, it can only reach a distance of 160 yards The outbreak of springs has no bearing on the duration of a drought

Oct 3 —W F **Blakely** Description of three new Eucalypts and one new Acacia Two of the new species of *Eucalyptus* are stringybarks, the other belongs to the Hemiphloia group and is allied to the broad leaved peppermints The acacia is an interesting alpine species with affinities to *A podalyriæfolia*

Official Publications Received

BRITISH

Board of Trade. British Industries Fair, 1929 The White City Shepherd's Bush London W 12 February 18th–March 1st. Organised by the Department of Overseas Trade. Special Overseas Advance edition Pp. xvi+400+Ad 250 (London Board of Trade) 1s

Department of Agriculture Trinidad and Tobago Witch Broom Disease of Cacao and its Control By F Stell and Note by the Hon A B Carr Appendix What is a Fungus? by F Stell Pp. 19+3 plates (Trinidad B W I Government Printing Office Port of Spain) 9d

Publications of the Dominion Astrophysical Observatory Victoria B C Vol 4 No 5 The Spectroscopic Orbit of H R. 5702 and Velocity and Light Curves of 12 Lacertae. By William H Christie Pp 55 66 Vol 4 No 6 The Orbits of the Spectroscopic Components of the two Helium Stars H D 19820 and H D 176853 By J A. Pearce Pp 67 79 Vol. 4 No 7 Two A type Binaries and the Radial Velocities of 50 Stars By R M Petrie Pp 81 95 Vol. 4, No 8 The Spectroscopic Orbit of H D 176819 and a Note on H D 185936 By P M Millman Pp 97 101 Vol. 4, No 9 Two Spectroscopic Orbits and Notes on υ Sagittarii By J S Plaskett. Pp. 103-118 (Victoria B C)

Royal Society of Arts John Street Adelphi, London, W C 2 Report on the Competition of Industrial Designs 1928 Pp. 46 (London)

Papers of the Society of Painters in Tempera. Edited by M Sargant-Florence. Vol. 1 1901–1907 Second edition, revised and brought up to date with Appendix by the Society of Mural Decorators and Painters in Tempera. Pp. ix+96 (Brighton The Dolphin Press.) 10s. 6d.

FOREIGN

Geology and Water Resources of Palestine. By G S. Blake. Pp. 51 (Jerusalem Department of Lands.) 100 mils

Annual Report of the Board of Regents of the Smithsonian Institution showing the Operations, Expenditures and Condition of the Institution for the Year ending June 30, 1927 (Publication 2927) Pp xii+580+99 plates. (Washington D C Government Printing Office) 1 75 dollars

Stanford University Publications University Series. Biological Sciences, Vol 5, No. 2 The Fossil Fishes of the Miocene of Southern California, Contribution No. 9 By David Starr Jordan Pp. 16+4 plates. (Stanford University, Calif. Stanford University Press.) 50 cents.

CATALOGUES.

Catalogue of B D H. Fine Chemical Products. (January 1929) Pp. 180 (London The British Drug Houses, Ltd.)

The Photo-electrical Recording Photometer Second edition. (Mess 469/II) Pp. 7 Photograms taken with the Recording Photometer (Mess 469b.) Pp. 4. (London and Jena Carl Zeiss, Ltd)

Diary of Societies

FRIDAY, JANUARY 18

TEXTILE INSTITUTE (Lancashire Section) (at Manchester), at 1 15 —J P O Callaghan Water Softening for the Textile Industries

BRITISH INSTITUTE OF RADIOLOGY (Medical Members), at 5 —Informal Discussion on Gastro-intestinal Cases.

ROYAL COLLEGE OF SURGEONS OF ENGLAND at 5 – Sir Arthur Keith The Anatomy and Evolution of the Human Brain

SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (at Liverpool University), at 6 — C Gordon Smith Common Salt.

INSTITUTION OF MECHANICAL ENGINEERS, at 6 — J G Weir Modern Feed Water Circuits.

INSTITUTION OF CHEMICAL ENGINEERS, (at Institution of Civil Engineers), at 6.30.—Prof J W Cobb The Reactivities of Solid Carbon in Fuel Processes (Lecture).

SOCIETY OF DYERS AND COLOURISTS (Manchester Section), at 7 —Dr S G Barker The Standardisation of Fastness of Dyestuffs on Dyed Fabrics

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group), at 7 —M O Dell Some Recent Prints from the Pyrenees

GLASGOW SOCIETY OF DYERS (at 7 Gordon Street Glasgow), at 7 15 — A J Hall The Action of Swelling Agents on Artificial Silk

JUNIOR INSTITUTION OF ENGINEERS, at 7 30 —J F Petree Notes on the Fitting and Operation of Michell Bearings

OIL AND COLOUR CHEMISTS ASSOCIATION (Manchester Section) (at Milton Hall Manchester), at 7 30 —Dr J J Fox The Examination of Paints.

INSTITUTION OF AUTOMOBILE ENGINEERS (Scottish Graduates) (at 51 West Regent Street Glasgow) at 8 —J Swan Dynamometers

ROYAL SOCIETY OF MEDICINE (Pathology Surgery and Obstetrics Sections), at 8 —Special Discussion on Post-operative Thrombosis. Openers W H Evans (Pathology), D H Patey (Surgery), V Bonney (Obstetrics)

ROYAL SOCIETY OF MEDICINE (Electro-Therapeutics Section) at 8 30 — C T Holland Epiphyseal Injuries of the Wrist Joint.—Dr R. S Patterson Some Factors Influencing Epiphyseal Growth and Union

ROYAL INSTITUTION OF GREAT BRITAIN, at 9 —Sir William Bragg Further Progress in Crystal Analysis

TODMORDEN TEXTILE SOCIETY (at Todmorden) —H P Curtis Cloth Testing and Examination from the Manchester Man's View

SATURDAY JANUARY 19

GEOLOGISTS ASSOCIATION (at Museum of Practical Geology Jermyn Street), at 2 30 —Dr R Crookall Demonstration of Coals their Composition and Origin

PHYSIOLOGICAL SOCIETY (at National Institute for Medical Research Mount Vernon Hampstead), at 9 —Dr H H Dale H W Dudley H P Marks, and J H Gaddum A Choline Ester (?) in Extracts of Spleen —Prof L Hill Sphygmometry of the Vessels of the Frog's Leg —J A. Campbell and T Angus Water Evaporated from the Body in Relation to Work.—J A Campbell Tensions of Gases in Tissues. (a) Effects of CO Poisoning (b) Hydrogen in the Peritoneal Cavity —F M Durham Effect of Alcohol on Genetic Behaviour of Guinea Pigs —H V Horton and W Dullère Reversible Loss of Excitability in Isolated Amphibian Voluntary Muscles.—W Dullère The Condition of Creatine in Amphibian Voluntary Muscle —D W Bronk The Energy Expended in Maintaining a Contraction —Prof A V Hill The Restoration of Fatigued Muscle by Washing with Oxygen free Ringer's Fluid —H E Magee Further Experiments on the Movements of Isolated Intestinal Loops —A N Drury and A Szent-Györgyi The Influence upon the Heart of a Substance Present in Heart Muscle and other Tissues.—Demonstrations —J A Campbell (a) Effects of Prolonged Exposure to Low Tensions of Oxygen (b) Gas Tensions at the Surface of the Skin of Man —Prof L Hill A Katathermometer Graduated for Warm Atmospheres —Prof L Hill and J McQueen Capillary Circulation in Liver of Mouse.—R. B Bourdillon and R. G C Jenkins Methods of Measuring Absorption of Ultra violet Rays.—A. Eidinow Sensitisation to Fluorescent Radiation —Dr H H Dale Complete Artificial Perfusion of the Liver —J H Gaddum (a) Use of Richards-Collison Metabolism Apparatus for Thyroxin etc, (b) An Outflow Recorder for Rapid Flows —H E Magee and J J R. Macleod Diffusion through the Wall of the Living and Dead Intestine

ROYAL INSTITUTION OF GREAT BRITAIN at 3.—Dr E. Cammaerts Flemish and Belgian Art (1) The Portrait

BRITISH ASSOCIATION OF MANAGERS OF TEXTILE WORKS (at Athenæum Manchester), at 6 30 —W A. Hanton Recent Loom Design (Lecture).

HULL ASSOCIATION OF ENGINEERS (at Municipal Technical College Hull) —J Evans Modern Steam Condensers and Feed Systems

MONDAY, JANUARY 21

ROYAL SOCIETY EDINBURGH, at 4.30.—R. B. Mooney and E. B. Ludlam The Thermal Equilibrium between Ethylene, Iodine, and Ethylene Di Iodide —E B Ludlam, H G Reid and G S. Soutar The Hydrogen Chlorine Flame.—R. W Armour and E B Ludlam Photochemical Equilibrium between Hydrogen Bromine, and Hydrogen Bromide.—W W Taylor Demonstration of a New Method of Determining Free and Bound Water —W W Taylor The Lyotrope Effect and the Antagonistic Action of Ions.—W O Kermack, A. G M Kendrick and Eric Ponder The Stability of Suspensions III. The Velocities of Sedimentation and of Cataphoresis of Suspensions in a Viscous Fluid

VICTORIA INSTITUTE (at Central Hall Westminster), at 4.30 —Rev C W Cooper Precious Stones of the Bible, with Special Reference to the High Priest's Breast Plate.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 —Sir Arthur Keith The Anatomy and Evolution of the Human Brain.

TEXTILE INSTITUTE (London Section) (at Clothworkers Hall), at 6 — G Garnett Woollens and Worsteds Customs Designation (Lecture).

INSTITUTION OF MECHANICAL ENGINEERS (Graduates Section London) (jointly with Students Sections of Institution of Civil Engineers and Institution of Electrical Engineers), at 6.30.—H R. Sketch Engineering Insurance.

INSTITUTION OF AUTOMOBILE ENGINEERS (jointly with Western Centre and West of England Branch of Institution of Mechanical Engineers) (at Merchant Venturers Technical College Bristol), at 6 45 —Dr H. J Gough Recent Developments in the Study of the Fatigue of Materials.

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (at Liverpool University), at 7 —Capt. J M Donaldson, J G Hines, and others Discussion on The Anticipation of Demand, and the Economic Selection Provision, and Layout of Plants.

INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (at Birmingham University), at 7 —Capt P P Eckersley Lecture on Wireless.

SOCIETY OF CHEMICAL INDUSTRY (Yorkshire Section) (at Great Northern Hotel Leeds), at 7 15 —Prof R. D Passey Poisoning and Disease in Industry (II) Industrial Cancers.

INSTITUTION OF AUTOMOBILE ENGINEERS (Glasgow Centre) (at Royal Technical College, Glasgow), at 7 30 —M Platt Safety in Four Wheel Braking Systems

BRADFORD TEXTILE SOCIETY (at Midland Hotel, Bradford), at 7 30.—W O R Holton The Uses of Laps, Wastes Shoddy, etc. (Lecture)

HUDDERSFIELD TEXTILE SOCIETY (at Huddersfield Technical College) at 7 30 —D R H Williams Costings (Lecture).

ROYAL SOCIETY OF ARTS, at 8.—Dr C H Lander The Treatment of Coal (Cantor Lectures) (I)

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8 30 —O P Milne Criticism of Work submitted for Prizes and Studentships Presentation of Prizes

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8 30 —J R. Baker The Northern New Hebrides.

TUESDAY, JANUARY 22.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5 15 —Dr F A. Freeth Critical Phenomena in Saturated Solutions (II)

INSTITUTION OF CIVIL ENGINEERS, at 6 —J M Hyde and H R. Lintern The Vibrations of Roads and Structures

INSTITUTION OF ELECTRICAL ENGINEERS (North Western Centre) (at Engineers Club, Manchester) at 7 —Capt. J M Donaldson J G Hines, and others Discussion on The Anticipation of Demand and the Economic Selection Provision, and Layout of Plants

ILLUMINATING ENGINEERING SOCIETY (at Home Office Industrial Museum Horseferry Road), at 7 —Dr I C Martin Colour and its Applications

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN at 7 —W Bickerton The Moods and Emotions of Birds.

INSTITUTION OF AUTOMOBILE ENGINEERS (Coventry Graduates) (at Broadgate Cafe, Coventry) at 7 15 —Mr Wheeler Jigs

INSTITUTION OF AUTOMOBILE ENGINEERS (London Graduates Informal Meeting) (at Watergate House), at 7 25 —J F Ward The Training of Drivers

INSTITUTION OF ELECTRICAL ENGINEERS (North Eastern Students Section) (Jointly with Newcastle and District Association of Institution of Civil Engineers) (at Mining Institute Newcastle on Tyne), at 7 30 —A. Page The Development of Generation and Distribution of Electrical Power in the British Isles

SHEFFIELD METALLURGICAL ASSOCIATION (at Sheffield), at 7 30 —C H Faris The Applications of Electro-deposited Metals to Engineering

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Cardiff) —Dr T Lewis The Training of an Ophthalmic Optician

MANCHESTER ATHENÆUM TEXTILE SOCIETY (at Manchester). —C A. Harrington Artificial Silk and its Application to Fabrics (Lecture).

WEDNESDAY JANUARY 23

ELECTRICAL ASSOCIATION FOR WOMEN (at 148 Knightsbridge) at 4 —A. B Read Modern Decorative Lighting of Interiors

ROYAL SOCIETY OF MEDICINE (Comparative Medicine and Tropical Diseases Sections), at 5 —Prof F T G Hobday, Prof G H Wooldridge Dr Minett, J W McIntosh, E A West, and others Special Discussion on Glanders and Kindred Diseases

ROYAL COLLEGE OF SURGEONS OF ENGLAND at 5 —Sir Arthur Keith The Anatomy and Evolution of the Human Brain.

GEOLOGICAL SOCIETY OF LONDON at 5.30 —Dr A Jowett and Prof J K Charlesworth The Glacial Geology of the Derbyshire Dome and the Western Slopes of the Southern Pennines —Prof J K Charlesworth The South Wales End Moraine

NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY (at Institution of Automobile Engineers Watergate House, Adelphi), at 5 30 —Rhys Jenkins A Chapter in the History of the Water Supply of London—A Thames side Pumping Installation and Sir Edward Ford s Patent from Cromwell.

INSTITUTION OF AUTOMOBILE ENGINEERS (Manchester Centre) (at Engineers Club, Manchester), at 7 —M Platt Safety in Four Wheel Braking Systems.

ALCHEMISTS SOCIETY (at Glasgow University) at 7 30 —Prof H. E Armstrong The Future Alchemist

ROYAL SOCIETY OF ARTS, at 8 —Sir Henry A. Miers Museums and Education

EUGENICS SOCIETY (at Royal Society), at 8 30

HASLINGDEN AND DISTRICT TEXTILE SOCIETY (at Grammar School, Haslingden) —H Bromiley Processes from the Field to the Finished Yarn (Lecture).

THURSDAY, JANUARY 24.

ROYAL SOCIETY, at 4.30 —Dr D Denny Brown (*a*) On the Nature of Postural Reflexes , (*b*) The Histological Features of Striped Muscle in Relation to its Functional Activity —W S. Stiles The Effect of Glare on the Brightness Difference Threshold —L J Harris The Combination of Proteins, Amino-Acids, etc. with Acids and Alkalis Part II Titration Curves of Amino-Acids, in presence of Formol.—*Papers to be read in title only* —Dr F W R. Brambell and G F Marrian Sex reversal in a Pigeon (*Columba livia*).—Prof J B. Gatenby and Sylvia Wigoder (*a*) The Effect of X radiation on the Spermatogenesis of the Guinea Pig (*b*) The Post-Nuclear Body in the Spermatogenesis of *Cavia cobaya* and other Animals.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15—Gordon Home Roman London (II).

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—J Wright and C. W Marshall The Construction of the Grid Transmission System in Great Britain.

INSTITUTION OF THE RUBBER INDUSTRY (Manchester and District Section) (at St. Mary s Parsonage Manchester), at 7 —Dr E. G Ritchie Storage of Steam.

ROYAL AERONAUTICAL SOCIETY (at St. Ermin s Hotel, Caxton Street), at 7 30 —Informal Discussion on The Compression Ignition Engine for Aircraft.

ROYAL SOCIETY OF MEDICINE (Urology Section), at 8.30.—Sir William de Courcy Wheeler Traumatic Rupture of the Urethra.

FRIDAY JANUARY 25

INSTITUTION OF ELECTRICAL ENGINEERS (Irish Centre—Dublin) (at Gaiety Theatre Dublin), at 4.—Ll. B. Atkinson How Electricity does Things (Faraday Lecture)

ASSOCIATION OF ECONOMIC BIOLOGISTS (Annual General Meeting) (in Botany Lecture Room, Imperial College of Science and Technology), at 5.—S G Tallents The Work of the Empire Marketing Board

PHYSICAL SOCIETY (at Imperial College of Science), at 5.—Prof C V Boys A Fused Quartz Pendulum Rod for Clocks. G W Sutton A Method for the Determination of the Equivalent Resistance of Air Condensers at High Frequencies —L. Hartshorn The Measurement of the Anode Circuit Impedances and Mutual Conductances of Thermionic Valves

ROYAL SOCIETY OF MEDICINE (Children Section) at 5

ROYAL COLLEGE OF SURGEONS OF ENGLAND at 5 —Sir Arthur Keith The Anatomy and Evolution of the Human Brain

SOCIETY OF CHEMICAL INDUSTRY (Birmingham and Midland Section) (at Engineers Club Birmingham), at 7 —Prof W E S Turner Communications from the Department of Glass Technology The University Sheffield

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemical Section), at 7

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7 —F T Usher Bromoil

WEST OF SCOTLAND IRON AND STEEL INSTITUTE (at Royal Technical College Glasgow), at 7 —J Mitchell The Manufacture of Iron and Steel Tubes

INSTITUTION OF ELECTRICAL ENGINEERS (North Eastern Students Section) (at Armstrong College Newcastle upon Tyne), at 7 15 —S. Gibson The City of Winnipeg Hydro-electric Power Station

BLACKBURN TEXTILE SOCIETY (at Bradford Technical College) at 7 30 —W Wilkinson Power Loom Pickers and Picking (Lecture).

JUNIOR INSTITUTION OF ENGINEERS at 7 30 —M J McCarthy Notes on Winches Derricks and other Lifting Appliances used in Modern Building Construction

ROYAL SOCIETY OF MEDICINE (Epidemiology Section), at 8 —Dr Ledingham Dr G F Buchan and others Discussion on Vaccination Against Smallpox in the Light of Recent Experience

ROYAL INSTITUTION OF GREAT BRITAIN at 9 —Prof A C Seward The Vegetation of Greenland

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ROYAL INSTITUTION OF GREAT BRITAIN at 3 —Dr E Cammaerts Flemish and Belgian Art (II) The Landscape

PUBLIC LECTURES

FRIDAY, JANUARY 18

UNIVERSITY COLLEGE at 5 —C F Pantin Comparative Physiology (Succeeding Lectures on Jan 25 Feb 1, 8, 15, 22 Mar 1 8, 15 and 22.)

SATURDAY JANUARY 19

HORNIMAN MUSEUM (Forest Hill), at 3 30 —D Martin Roberts London through the Ages.

MONDAY, JANUARY 21

EAST ANGLIAN INSTITUTE OF AGRICULTURE (Chelmsford), at 7 —F Rayns The Cultivation of Sugar Beet.

WEDNESDAY JANUARY 23

IMPERIAL COLLEGE OF SCIENCE—ROYAL SCHOOL OF MINES, at 5 30 —Dr A McCance Some Applications of Physical Chemistry to Steel Manufacture (Succeeding Lectures on Jan. 24 30, and 31)

THURSDAY, JANUARY 24

UNIVERSITY COLLEGE, at 5 —Dr R. J Ludford Cytology in Relation to Physiological Processes. (Succeeding Lectures on Jan. 31 Feb 7, 14 21, and 28).

BEDFORD COLLEGE FOR WOMEN at 5 15 —W P Yetts Chinese Architecture

SATURDAY, JANUARY 26.

HORNIMAN MUSEUM (Forest Hill), at 3 30.—H. Harcourt The Lure of India.

CONFERENCE

SATURDAY JANUARY 19

JOHN INNES HORTICULTURAL INSTITUTION (Merton), at 2.30 —Conference on Polyploidy in Relation to Species and Horticultural Varieties.

Dr C C Hurst Polyploidy in the Genus *Rosa*.
Prof R. R. Gates The Origin of Polyploids.
J B S. Haldane Laws of Inheritance in Polyploids.
Dr C D Darlington The Importance of Chromosome Behaviour in Polyploids.
Dr C. L. Huskins Polyploidy in Cereals.
M B. Crane Polyploidy in Strawberries, *Rubus* and *Prunus*
Miss Caroline Pellew *Primula Kewensis* and Species Hybrids
Dr F W Sansome Polyploidy in Tomatoes.

SATURDAY, JANUARY 26, 1929

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Scientific Research and Tropical Development

IN the three previous reports on the Colonies for which he was either wholly or partly responsible, Mr Ormsby Gore had perforce to deal at length with constitutional and political issues, questions of land tenure and other land problems, and labour problems But the constitution of British Malaya is not at present a subject of controversy, the constitutional and political problems of Ceylon have been dealt with specifically by the Donoughmore Commission and the constitution of Java, a Dutch Colony, is obviously not a matter upon which a British Minister should be expected to express opinions Apparently there are no difficult land or labour problems in British Malaya and Ceylon Consequently, in his report on British Malaya, Ceylon, and Java (Cmd 3235, H M Stationery Office, 1928, 4*s* 6*d*), Mr Ormsby Gore is able to deal exhaustively with the subject nearest to his heart, the application of science to those public services upon which the physical health and the wealth and intellectual progress of communities depend

It must be confessed that in this report he shows himself far more critical of the attitude of local governments and non official Europeans towards their problems than in any previous report This can be attributed to the fact that he brings to bear upon these problems the knowledge and experience he has gained by his visits to other colonies, and the contacts he has made with scientific workers, educationists, and technicians throughout the whole Empire During the past five years he has served on every government committee set up in Great Britain for the furtherance of education, public health, and scientific research in the Empire, and he has thrown himself whole heartedly into the work Probably no public man, certainly no Minister of the Crown, has ever had such opportunities for making himself personally acquainted with the tasks confronting workers in these three important fields of endeavour, and the workers themselves Small wonder that his grasp of the essentials of tropical development has developed or that his critical faculty has been sharpened

There is evidence that the white community, in Malaya at least, is not altogether satisfied with the results of Mr Ormsby Gore's visit He has discovered too much and been too outspoken a critic to earn popularity Business men in Malaya are probably like business men everywhere, inclined to attribute their successes to their own brains and

initiative and all their failures to the government, at one moment to cry aloud to the government for protection, at the next to curse the government for its interference, to beg for government assistance in their various enterprises, and then to criticise the government for its increased expenditure in satisfying their demands We are only too familiar with these moods of 'business' men and farmers in post War England We know, too, how bitterly they resent being shaken from their com placent belief in their own super efficiency by well informed criticism, with what Micawberish opti mistic obstinacy they wait upon events, trusting to luck, instead of courageous reorganisation to meet changing conditions, to bring back prosperity But heirs to prosperity are notoriously blind to the facts of history The European planters in British Malaya are no exception to rule They have acquiesced in the starvation of the research and technical services In consequence they have lost several of the best officers of the Agricultural Department They disregarded for fifteen years the advice of the Agricultural Department on the subject of soil erosion on rubber estates They have disregarded the work being done by the Dutch in Java The big rubber plantation com panies are now seriously threatened by the native small holder Naturally, it must be galling to them to be told by Mr Ormsby Gore that

"The only justification for the present compli cated and expensive mechanism of directors, agent firms, visiting agents, managers, and shareholders is the application of greater intelligence and skill than the native can reasonably be expected to acquire"

Lest this were not sufficient blow to their self esteem, they are informed also

"It is to the individual enterprise, industry, and thrift of the Chinese merchant and petty trader, the Chinese craftsman, the Chinese coolie, and above all the small Chinese contractor with his 'Kongsi' or guild, that the great wealth and develop ment of British Malaya are mainly due"

It will be remembered that, when Great Britain was suffering from acute trade depression in 1921–22, the government appointed a commission under the chairmanship of Sir Eric Geddes to inquire into government expenditure with the view of effecting economies therein Had that commission's recom mendations been put into effect, practically the whole of the government's research and technical services would have been crippled, and a severe blow been administered to the education services of the country British Malaya is now faced with trade depression owing to the fall in price of rubber and tin, its two chief economic commodities If his opinion reflects that of the present government, Mr Ormsby Gore's comments on the situation indicate the distance and the direction in which his colleagues have travelled since 1922 He says

" economies in the public services will no doubt have to be considered On the other hand, there can be little doubt that further development and expansion depend very largely on an active and progressive policy on the part of the technical departments, such as agriculture, public health, education, forestry, veterinary, railways, and public works The higher staffs of these services are recruited by the Secretary of State for the Colonies, and Malaya cannot afford other than the best men available"

He states further that

' the scientific services have not hitherto always received that recognition which can alone ensure an adequate supply of up to date technical officers possessed of that training and leadership which are required for modern development"

We are informed that the Malayan Agricultural Department at Kuala Lumpur has not been properly supported At the present time, in spite of the signal proofs its officers have given of their capacity to improve the crops of the country, "its present accommodation in the way of offices is overcrowded and inadequate" The large field station initiated at Serdang in 1921 has no laboratories, the nearest being the Kuala Lumpur laboratory, seventeen miles away, which makes it difficult to maintain any close or continuous touch with it Again, since there is no agricultural school in Malaya — in marked contrast to Java, which has an admirably co ordinated system of agricultural education—' the liaison between the work of the Department and European or native agriculturists is still very im perfect The Department has in fact worked in isolation under grave disadvantages and often neglect" There is now a Rubber Research Institute at Kuala Lumpur, but this was started only in 1925 Mr Ormsby Gore says he is con vinced that on research rather than restriction depends the prosperity of the rubber industry," but there are still many plantation companies which look to the government to fix prices on the basis of what the least efficient estates consider a reasonable level, and ignore scientific research Animal industries in Malaya, due to the fact that there is no real veterinary department, are not being developed

The agricultural situation in Ceylon is much more hopeful Public opinion in Ceylon is now very much alive to the need for furthering research in agricul ture ' At Peradeniya, there are the headquarters

of the Agricultural Department, the Botanic Gardens, a central experimental station, central laboratories and library, a farm school, and the head office of the Ceylon Rubber Research Institute Agriculture now forms part of the curriculum of two of the voluntary secondary schools, each of which has its own farm, namely, Trinity College, Kandy, and Richmond College, Galle 748 Government and 100 assisted schools have school gardens There is a separate Tea Research Institute, financed by a cess on all tea exports, at present located in temporary quarters at Nuwara Eliya There is also a separate Veterinary Department with a Central Laboratory at Colombo at which "some excellent research work has been done" The Government Dairy Farm in Colombo and the branch farm at Ambepusa, under the control of the Veterinary Department, provide facilities for breeding and feeding experiments

"Ceylon,' Mr Ormsby Gore reminds us, "is, after India, the largest tea producing country in the world It is the chief exporter of coconuts and coconut products in the Empire It ranks third in the world as a producer of rubber It is the principal producer in the world of cinnamon and citronella It produces the highest grade and highest priced cocoa" Coffee was once an important crop, but this industry was practically wiped out by disease, particularly *Hemeleia vastatrix* In the opinion of experts, however, modern Java *robusta* coffees, highly resistant to disease, would do well in Ceylon and prove commercially profitable The rice area could also be extended with advantage, particularly if more research were directed towards increased yields per acre Mr Ormsby Gore also suggests that sisal might profitably be introduced into the dry zone and the natives be encouraged to grow tobacco as a rotation crop to sesame (locally known as 'gingelly')

While the Ceylon Agricultural Department is ahead of the corresponding service in British Malaya, the reverse aspect is presented by the respective forestry services The Malayan Forestry Department is well staffed, it has achieved a uniform policy throughout the peninsula, and its research, experimental planting, conservation and commercial development sections, are all doing admirable work in accordance with a properly co ordinated plan It is true that British Malaya, in spite of the fact that four fifths of the territory is under forest, still imports large quantities of timber from the neighbouring Dutch colonies, but it is hoped that it will not be long before it is entirely self supporting in this respect The need for a well defined forestry policy with regulations directly enforced by the administration is emphasised by the fact that the Conservator of Forests estimates that 75,000,000 tons of timber in the most accessible areas have been wasted by the ruthless burning out of forests to make room for rubber plantations or to mine for tin

As regards Ceylon, we are informed that there was no effective forestry control or policy until 1907 For generations before that the best and most valuable trees had been cut out indiscriminately 'The export of satinwood from Ceylon was very extensive in the early years of the nineteenth century, and little or nothing was done until quite recently in the way of conservation, regeneration, and improvement of forests by scientific clearing or planting Even when the Forestry Department was first established (in 1907), the policy then adopted was wrong, uneconomic, and unscientific' Not until 1921 was any attempt made to rectify matters In that year a report was made by a visiting forestry officer, after which a Commission was appointed to make an exhaustive inquiry This Commission took five years to complete its work, and "*the putting into force of its many proposals is still under consideration* (Italics ours)

The sections of Mr Ormsby Gore s report dealing with the public health services of the two British Colonies are informative, illuminating, and suggestive In attaching the greatest importance to preventive as compared with curative medicine, he is following the best precepts of our time 'There is no part of the Empire where the progress of medical and sanitary science can be studied with greater advantage than in British Malaya,' he informs us For climatic and ecological reasons Malaya is naturally highly malarious, and "malaria is still the disease responsible for the highest mortality in both the Straits Settlements and those Federated Malay States where vital statistics of sufficient scientific value are obtainable" In addition to high mortality, "malaria is the main indirect cause of debility, suffering, and death from other causes" Again, the tropical peoples of Malaya, like those in other parts of the tropics, possess very little resistance to pneumonia and tuberculosis As in other tropical countries also, helminthic and venereal diseases cause much debility and loss of efficiency among the peoples of Malaya The venereal disease problem of Singapore is aggravated by the fact that Singapore city "is one of the main ports of the world visited by vessels of every flag from every country"

Mr Ormsby Gore pays tribute to the public

health authorities in British Malaya for the work which has been and is being done to cope with these many difficult problems He also commends the public health work which has been undertaken by private enterprise on the part of rubber and mining companies, and the pioneer work of such private practitioners as Sir David Galloway and Sir Malcolm Watson In particular, he says the anti malarial work of the Malay States is rightly held up as an example among the countries of the world Again, he states that the medical research services and the provision made for medical education are alike excellently conceived and efficiently carried on It is in no spirit of carping criticism that he suggests the existing dichotomy in the public health services in Malaya should be ended, that every medical practitioner in a tropical climate should be a sanitarian, that the financial rewards available to the public health worker as compared with those obtainable in ordinary medical private practice should be reconsidered, and that more liberal leave should be given to the officers of the public health services of Malaya to enable them to take refresher courses at the London School of Hygiene and Tropical Medicine

A different note is struck on the Ceylon public health services Ceylon has the most extensive and expensive hospital system of any British possession, but " medical research, modern medical practice, public health services, and preventive medicine in Ceylon are not up to modern standards and are below the public need ' It is Mr Ormsby Gore's impression ' that in medical education and practice the community as well as a large section of the medical profession in Ceylon are still living in the nineteenth rather than the twentieth century ' Accordingly, he throws out a series of important suggestions for consideration by the government and the public in Ceylon, in which he emphasises the need for a new central medical research institute, an overhaul of the medical education work, improved status and conditions of service for public health officers, and the teaching of personal and public hygiene in all schools

We have dealt extensively but by no means exhaustively with this report by Mr Ormsby Gore His views on other subjects connected with the economic development and intellectual progress of the peoples of the East Indies and Ceylon for whom Europeans have assumed responsiblity will repay the most careful study by all interested in the development of the British Empire, and in particular by those who wish to understand what science has done and still can do for our subject peoples There is a certain unenviable forbidding notoriety attached to blue books printed for the special edification of members of Parliament, which militates against their wide distribution among all classes of the population This is unfortunate, because the reports of Mr Ormsby Gore are full of accurate information, presented in easily assimilable form, which would be invaluable to students in all our secondary schools They are a liberal education in themselves, and free copies might with advantage be distributed by the Board of Education to all schools in the country The expense would be negligible in comparison with the interest they would awaken One thing is certain all scientific workers with a regard for the profession to which they belong should take the first opportunity to make themselves acquainted with the contents of this last report on Malaya, Ceylon, and Java They will not only find there a complete justification for themselves and their special studies, but also will be made more fully aware of their responsibilities to the world at large and their potentialities for good In the Under Secretary for the Colonies they have a firm friend and doughty and authoritative protagonist

In congratulating Mr Ormsby Gore on his signal achievement, we are conscious of the debt of gratitude we owe to his labours on behalf of science

British Folklore

(1) *English Folklore* By A R Wright (Benn's Sixpenny Library, No 33) Pp 80 (London Ernest Benn, Ltd , 1928) 6*d*

(2) *Folklore of the British Isles* By Eleanor Hull (Methuen's Anthropological Series) Pp xii + 318 (London Methuen and Co , Ltd , 1928) 7*s* 6*d* net

BOTH these books appeared opportunely Their date of publication falling near the jubilee congress of the Folklore Society, they served to supplement the proceedings of that congress in demonstrating to the general public a broader conception of the aims and methods of the study of survivals It is patent from incidental references and the occasional correspondence in the daily press that there is a widespread interest among the public in the vestiges of our popular custom and belief , but there is little evidence of appreciation of the fact that these queer practices are worthy of serious study or that their collection or record has any object other than the satisfaction of a curiosity about the past The collection of facts is indeed of paramount importance, especially

when the material is disappearing rapidly before the spread of education and the standardisation of culture which must ultimately obliterate local peculiarities; but it is not the exclusive end of the study, and unless the material acquired is surveyed periodically on broad lines in relation to the general problems of the science, there is a danger that it may cease to be regarded seriously and fail to attract the public interest and support without which in present conditions scientific research can scarcely maintain its full vigour and attract serious workers. At the recent Folklore Congress, conditions in England were contrasted with those on the Continent, where, it was pointed out, in various countries chairs in the study of the folk have been established, and it has been introduced into school curricula. But to secure even academic support a study must justify its existence.

Though this is not the occasion for a review of the methods of folklore studies during the last fifty years, it is necessary to emphasise the needs which Miss Hull and Mr. Wright have met in order that their work may be fully appreciated. To the achievements of their great predecessors, Frazer, Gomme, Hartland, Miss Burne, and all who assisted in the compilation of the "Handbook of Folklore," they would be the first to pay homage. But much that was implicit in the works of these writers has been made explicit and reviewed in the light of later knowledge; much that was intended for the needs of the student has been made accessible to a wider public. Though both Miss Hull and Mr. Wright confine themselves to a specific geographical area, the principles upon which their analysis proceeds are of general application.

(1) Mr. Wright's book will help to dispel any idea that few vestiges of popular belief and superstition, except on certain lines, remain in England. His little book is a remarkable feat of condensation, yet as it is, he has to express regret in a final chapter that he has been unable to deal with a number of subjects such as folk song and dance—the latter a fruitful subject—folk drama, proverbs and riddles, games, and folk art. Yet in seven chapters he has covered a multiplicity of subjects, such as birth, courtship, marriage, and death, business and work, calendar customs, ghosts and supernatural beings, divinations, charms, witchcraft, to name the most important; nor is his material obsolete or even mainly drawn from the records of the past. Nearly all his illustrative citations are of incidents which have occurred since the War. Of these, the cases of witchcraft may be familiar, as they receive more notice in the Press and tend to be remembered. One of the most remarkable was that at Newton Abbot in 1926 of a man who objected to his wife placing a ring of salt around his chair because she believed he had bewitched his son.

Mr. Wright is incorrect in placing the last ducking of a witch in Northamptonshire. The 'White Witch' who diagnosed the case came from Northamptonshire; the ducking took place in Hertfordshire. The victims lived at Tring. Although the panel of the Insurance Acts has done much to eradicate the popular pharmacopœia, the help of the white witch is still invoked. Mr. Wright records a charm for toothache which involves the insertion of human hair in a slit in the bark of an ash tree. It may be mentioned that American negroes also do this. The point is of interest, as much of the negro belief in the United States is European and not African in origin. Even the Voodoo cult is of European origin, in name certainly, and possibly to some extent in practice.

(2) Miss Hull's book differs from that of Mr. Wright in both scope and method. The latter lays down principles which are illustrated by examples of English folklore. Miss Hull aims at giving an account, as complete as her space allows, of the various phases and aspects of belief and custom in the whole of Britain from the earliest times of which there is any record susceptible of interpretation. For by inference we may probe even so far as the Stone Age, and legend and story take us back with certainty to the Iron Age. Both Mr. Wright and Miss Hull point out that Britain, having been overrun by people after people, its folklore is a series of superpositions of different racial beliefs. Yet it is remarkable how little can be identified as distinctively Saxon, while legendary lore is almost exclusively Celtic. Was this due to the fact that, while the Saxon conquerors were able to establish their institutions, their beliefs had no opportunity to become ingrained in the general mass of the population before they were overwhelmed or transformed by Christianity? Or was the general run of folk belief, apart from the pantheon, so closely akin as to escape subsequent discrimination? And when the Normans came, was a feudal practice imposed upon a ritual which had continued through Saxon from British times? Such, for example, would be the origin of the popular court held annually in some localities under an ash or other tree by the roadside and the 'gospel oak' as a boundary mark. So also the feudal due of a buck and doe offered at St. Paul's in London at the two feasts of St. Paul, for which

Miss Hull offers an explanation, which, by the way, was also suggested in our Calendar of Customs and Festivals (see NATURE, Jan 21, 1928, p 121)

So far as Britain is concerned, the cult of the horse may be peculiarly associated with the Saxons There are references to it in the chronicles additional to the evidence of archæological relics Miss Hull does not deal with the horse under 'animal cults,' but in connexion with one Irish practice, allows herself to accept, though apparently without strong conviction, the hard-worked explanation of totemism The kings of Cenel Conaill, Western Ulster, were consecrated by the ceremonial slaying of a white mare, in the broth of which the chieftain bathed, while his people solemnly partook of its flesh in a feast This certainly has all the appearance of an admission to a clan totem group and a ritual feast If it is so, this takes us back to a very primitive phase of Nordic belief, possibly before the cult of the horse had become even tribal But in India, where the horse is sacrificed by Aryan peoples, the rani must perform a certain rite with the sacrificed animal, which indicates either that it is identified with the rajah or is regarded as possessing marital rights over the women of the social group, that is, the act is an assertion of the divine individuality of the group, analogous to the assimilation of the Irish king to the divine identity of the group over which he is to rule

Miss Hull has dealt fully with most sides of British belief—well worship, tree worship, stone worship, worship of the sun and moon, animal cults, sacrifice, and so forth Her chapters on calendar customs are selective but illuminating Most of all, however, we are indebted to her for her systematic handling of the Irish material, of which her profound knowledge has enabled her to introduce order where it was badly needed, and at the same time to make known to a wider public in assimilable form much that is of profound interest in the history of the British Isles

The Properties of Silica.

The Properties of Silica an Introduction to the Properties of Substances in the Solid Non conducting State By Dr Robert B Sosman (American Chemical Society Monograph Series, No 37) Pp 856 (New York The Chemical Catalog Co, Inc, 1927) 12 50 dollars net

IT is unusual to write a whole volume about a single oxide of one of the elements, but if any oxide deserves this place of honour, it is certainly silica, since no other compound possesses such an array of interesting physical properties, even if we leave out of account all its chemical reactions A precedent for monographs of this type has been set by Le Chatelier's books on "Le Carbone" and "La Silice," and it is not a mere coincidence that the *doyen* of French chemistry should have selected silica as the subject of his second series of published lectures Le Chatelier's book, however, is of quite a different character, since it preserves the narrative form of the lectures, and tells a simple story in simple words Dr Sosman's book, on the other hand, is essentially a reference book, in which *all* the information about the physical properties of the various forms of silica is catalogued and reviewed

The book is made more formidable by the author's anxiety to use a logical method of classifying data, since he threatens in his introductory chapter to write a book of fifty seven chapters, in order to deal with all possible combinations of the six fundamental concepts of length, time, mass, electric charge, entropy, and energy, and in discussing the micro forms of quartz he insists that they may be 'micro' in one, two, or three dimensions (flaky, fibrous, or granular), and that these micro forms may be crystalline, amorphous, or aphanitic, so that nine classes are possible In these circumstances it is perhaps fortunate that the number of fundamental concepts is six and not twelve, and that the micro forms are not classified into triple groups according to a third or fourth property, so as to increase the nine classes to eighty one In the opinion of the reviewer, schemes of classification such as this should be concealed, like the working parts of a British locomotive, instead of being displayed ostentatiously like the working parts of some American and Continental engines In the present instance the author's determination to make his treatise complete, by including definitions of entropy, crushing strength, index of refraction and optical rotatory power, as well as tables showing the nomenclature of the thirty two classes of crystal symmetry and the classification of radiation over the range from γ rays to Hertzian waves, has led to the production of a volume of 856 pages, which is priced at 50s, and will therefore be purchased for the most part only by specialists and by reference libraries

As a reference book, however, this monograph is admirable, since it covers all the physical properties of silica in all its various forms Since quartz, tridymite, and crystobalite exist in two, two, and three forms respectively, there are eight distinct crystalline forms to be considered in addition to the

amorphous varieties The interconversion of these eight forms gives scope for the author's fondness for classification, although nothing at all is known about some of the possible transformations The 'high low' transformations of quartz, tridymite, and crystobalite are, however, totally different from those of the three main forms, since they do not proceed from nuclei or centres, but take place completely, reversibly, and almost instantaneously throughout the crystal when the inversion temperature is reached, so that it has actually been proposed to use one of them as a secondary standard in thermometry The same type of transformation is seen in the α β change in iron, but we have not yet reached a stage at which the two kinds of polymorphism can be discussed conveniently in elementary books on physical chemistry, since the underlying changes of structure are still open to discussion

From this point of view, X ray analysis is proving to be of fundamental importance, but in the case of quartz the progress hitherto made has not been sufficient to establish once for all an undisputed orientation of the atoms of silicon and oxygen, and the story which the author has to tell is therefore a long one instead of a short one Thus the chapter on "The Ultimate Structure of Silica" is followed by a chapter on "The Hypothetical Structure of Low Quartz," in which the views of McKeehan, W H and W L Bragg, Gibbs, Beckenkamp, Sohncke, Huggins, and Ichikawa are cited In the opinion of the reviewer, the key to the problem of the structure of crystalline silica is to be found in a recent paper by Prof F S Kipping on The Carbon silicon Binding" (*Trans Chem Soc*, p 104, 1927) in which he writes

"Fresh evidence is continually being obtained by the author that an ethylenic binding between carbon and silica is either impossible or can only be produced under exceptional conditions Those reactions which lead to the formation of an olefine seem to be quite inapplicable to the production of the group $>$Si C$<$"

This observation provides an excellent illustration of G N Lewis's view, that the formation of double bonds is different or impossible except between elements of the first short period If, then, we admit that silicon is unable to form a double bond, it follows at once that a molecule of silica must have an unsaturated structure, and in particular that each molecule of silica has four spare bonds just like an atom of carbon, thus

$$-\mathrm{O}-\underset{|}{\overset{|}{\mathrm{Si}}}-\mathrm{O}-\,,\quad \text{compare} \quad -\underset{|}{\overset{|}{\mathrm{C}}}-$$

The rise of boiling point from $-80°$ to $+2600°$ on passing from CO_2 to SiO_2 can then be attributed to the same cause as the rise of boiling point from $-196°$ to (say) $+3800°$, on passing from nitrogen to carbon, namely, the transition from a saturated molecule, $O=C=O$ or $N\equiv N$ to an unsaturated system, as formulated above

The discussions of the structure of the various forms of quartz are followed by sections dealing with the thermal and mechanical properties, the piezo electric and pyro electric properties, and finally the optical properties under the heading "Silica in the Periodic Electromagnetic Field" The data collected in these sections are so numerous that one can only assume that the collection is complete, and the reviewer is certainly not in a position to point to any gaps, apart from the lag that is inevitable when dealing with a subject that still plays an active part in current literature

The final section of the book deals with applications, and includes seven chapters, describing silica minerals and rocks, vitreous silica and silica refractories, the geological and industrial applications, and the chemical and physical uses of silica The whole volume is a monumental work which may be consulted with advantage by all those who want to know anything about silica but may not have access to the original literature, and even those who are seeking first hand information will find in it a trustworthy guide to the papers which they ought to read, and an excellent summary of their contents The only complaint that can be made is in reference to the possibility of having 'too much of a good thing,' since the elementary student might well be frightened if there were any prospect that all the chemical compounds of all the elements might be monographed in the same efficient way

T M LOWRY

Regional Geography of Great Britain

Great Britain Essays in Regional Geography By Twenty six Authors Edited by Alan G Ogilvie Published on the Occasion of the Twelfth International Geographical Congress at Cambridge Pp xxx + 486 (Cambridge At the University Press, 1928) 21*s* net

THE origin of this book is probably to be found in a conversation which the editor, Mr A G Ogilvie, had with a well known French geographer some two or three years ago Mr Ogilvie in his preface points out that there is a certain lack of modern authoritative geographical works dealing with Great Britain, and remarks that, although there are now twenty-one departments of geography

in universities and university colleges in Great Britain, no attempt had been made, until this book was planned, to gather together the accumulated experience of the heads of these departments and the results of their studies in their own regions He therefore made the suggestion to the British National Committee for Geography, a body which was formed on the initiative of the Royal Society, and is one of the constituent members of the International Geographical Union, that a composite volume should be published, to be written in the main by the heads of departments of geography, and that this volume should contain accounts of the geography of the various regions of the country by those who had specially studied them

This suggestion was approved by the National Committee, especially as it was accompanied by the proposal that the volume should be presented free to the foreign geographers attending the International Geographical Congress of July 1928 The National Committee formed a special committee to arrange for the production of the book

A general introduction is written by Sir John Russell, who, in the opening sentence, defines regional geography as the description of the regions of a country as they are and the discovery of the causes that have made them what they are, such a description would, no doubt, be taken to include the effect of the study of environment on the human generations that inhabit, or used to inhabit, the region Sir John Russell speaks authoritatively of the agriculture and soils of the country At the end of his introduction he mentions a fact of much interest to the student of population questions, namely, the curious change that is coming over the Clyde area, in which 'a large foreign population, chiefly Irish, is taking possession, ousting the Scotsmen, and doing by peaceful penetration what no previous invaders were able to do by force" The same process is commented upon by Mr Ogilvie at the end of his excellent account of central Scotland He remarks that there is evidence that the Irish in Scotland will increase while the Scottish race decreases, and that, unfortunately, many of the cream of the Scottish people are emigrating every year This "penetration of Protestant Scotland is viewed with alarm by many of her people, not so much on account of religious prejudice, as because of the social implications Scotsmen value above all their nationality and traditions" The movement of population thus indicated deserves the attention of all geographers

Dr H R Mill contributes an admirably clear article on the climate of Great Britain, and following this article of eighteen pages we come to the series of twenty three regional studies written by such authorities as Prof Fleure, who describes Wales, Prof Rishbeth, who deals with central south England, Mr Jervis, the Severn Basin, Dr Fawcett, the Pennines, Mr Fagg, the south-east of England, Prof Roxby, East Anglia, Mr Debenham, the Fenlands, Dr Rudmose Brown, the South Yorkshire Coalfield, Mr A Stevens, the Highlands and Hebrides, and a dozen other authorities, each writing with knowledge of the region dealt with

The writers were given a very free hand in describing the various areas, but there is, as a fact, a kind of general similarity of treatment In almost every case the regional study begins with an account, necessarily very brief, of the geology, then we usually find some description of the land forms and drainage system, followed by a note as to the climate, and in some cases, an account of the vegetation Then we arrive at the human side of geography, early settlement, changes in population, the character of the existing people, and agriculture and industry Added to these, which we may perhaps describe as the orthodox mixture, we shall find miscellaneous comments on such subjects as the future of certain of the great centres of population, the significance of certain town sites, regional planning, the distribution of population, and, of course, the study of human geography, the effect of place conditions on the human race is, indeed, the principal reason for the existence of the subject of geography at all, apart from the necessary work of exploring and mapping the earth's surface

The book is, from the nature of the case, condensed and 'facty' It must be taken in small doses, but so taken, the reader will find in it much of interest, and much that he probably did not know before One can obtain from it a good idea of the main conditions of human existence in the various characteristic divisions of Great Britain It is a book that everyone either learning or teaching the geography of Great Britain should possess It is well illustrated by figures and diagrams in black, but it will probably be found useful to study it with the additional aid of a quarter inch map of the region which is being studied at the time It should also be said that the book admirably fulfils its original purpose, namely, to present to the foreign geographers attending the International Geographical Congress "a synopsis by British geographers of the regional geography of Great Britain"

Our Bookshelf

Fever, Heat Regulation, Climate and the Thyroid Adrenal Apparatus By Dr W Cramer Pp ix + 153 + 40 plates (London Longmans, Green and Co, Ltd, 1928) 15s net

IN this interesting little volume the author adduces evidence in favour of his view that heat regulation in warm blooded animals is mainly under the control of the sympathetic nervous system, and that since the adrenal and thyroid glands are controlled by this system, the mechanism involved is both nervous and humoral The activities of the two glands have been followed by the histological method in the adrenal, fixation by means of osmic acid vapour discloses the presence in the resting medullary cell of fine black granules, which, from their absence from other cells and from their disappearance under conditions known to result in a secretion of adrenalin, are considered to indicate the presence of the base In the case of the thyroid, conclusions are drawn from the appearance of the colloid and cells lining the alveoli The numerous illustrations of drawings of actual microscopic sections show clearly the marked differences observable in the gland picture following exposure of the animal to heat or cold or injection of various compounds

An essential part of the author's thesis is the consideration of the glycogen in the liver as a secretion rather than as a simple store of surplus carbohydrate, the presence or absence of glycogen is not a measure of the activity of the glycogenic function, since the amount present depends solely on the balance between production and secretion from the cell, increased glycogen means hyper activity of the liver on the storage, inactivity on the secretory conception

In general, the author throws a new light on, or gives a new interpretation of, established facts, and thereby clarifies several problems, in one or two cases, however, the foundations of the thesis appear insecure, owing to the experiments on which he relies being unconfirmed or not generally accepted, as an example may be mentioned the question of the influence of the sympathetic nervous system upon the metabolism of skeletal muscle In his concluding chapters the author considers the relationships of climate and various pathological conditions to the heat regulating mechanism This is a most stimulating book, and should be read by all physicians, pathologists, and psychologists

Allgemeine Biologie eine Einführung in die Lehre vom Leben Von Dr Max Hartmann Zweiter Teil *Formwechsel und Reizerscheinungen* Pp v + 263 756 + ix (Jena Gustav Fischer, 1927) 25 gold marks

WHILE some of the material in this book is years out-of date, there are so many beautiful figures and descriptions from the works of the last generation of Continental zoologists, that the book will prove a very valuable addition to the library of the teaching zoologist Some of the work of Bělař especially, which is incorporated, is extremely fine The protozoological and cytological treatment is naturally very well done, if, as the reviewer has mentioned, a little behind the times It is possibly somewhat tiresome to have served up to one the descriptive cytology and protozoology of the Bouin's fluid and Schaudinn's fluid epoch The author would have done well if before finishing he could have read Wilson's "The Cell," but it would be cavalier to expect in a book of this size a treatment of various cytological subjects on the masterly lines of Wilson There is a quite fine chapter on developmental physiology, written, as indeed is the rest of the book, concisely and clearly The reviewer recommends teachers of zoology to obtain a copy of this work, because, in the absence of a good library, it will provide something from the work of the Continental protozoologists and cytologists The author is to be congratulated on the manner in which he has brought forward a great mass of material, and condensed it into a splendid work of seven hundred pages

J BRONTË GATENBY

Man a Machine in Answer to a Romantical and Unscientific Treatise written by Sig Eugenio Rignano and entitled "Man not a Machine" By Joseph Needham (Psyche Miniatures, General Series, No 12) Pp 111 (London Kegan Paul and Co, Ltd, 1927) 2s 6d net

THE author has revived the title of a discourse which appeared in 1748 under the authorship of M de la Mettrie, a Paris physician, who interpreted the nature of life on a basis of experiment and scientific observation So materialistic a view was bound to call forth many replies—for example, "Man More than a Machine," of unknown authorship, in 1750—most of which were based on anti-materialistic ideas, more especially relating to the soul

The controversy between the materialism of natural philosophy and the vitalism of the metaphysicians continues to experience periodic waves of revival, and again, in 1926, there appeared in this series of miniatures a philosophic presentation of Rignano's interpretation of life under the resuscitated title of "Man not a Machine" The booklet now under review is a reply to Rignano, in which the author presents scientific data, chiefly of a physico chemical and embryological character, as being more directly related to his own work Readers interested in a rational interpretation of living processes will find here some of the points at which the gradual encroachment of scientific method is continuously making inroads into the sacred preserves of vitalism

The Earth its Nature and History By Dr Edward Greenly (The Forum Series) Pp ix + 54 (London Watts and Co, 1927) 1s net

THE publishers of the Forum Series are gradually building up a library of cheap books of which they may well be proud Prof Julian Huxley and Sir Arthur Keith are among the earlier contributors, and now comes Dr Edward Greenly with a fascinating

little volume on geology In so far as it is possible profitably to discuss the make-up of the earth and its long history of changing landscape, climate, and life in 54 pages, Dr Greenly has succeeded where most of his competitors have failed His reputation as a brilliant but cautious geologist is so high that no one need doubt his authority to act as a guide to the beginner in a subject which is notoriously difficult to condense effectively The book is beautifully written—obviously it was a pleasure to write it—and is everywhere clear and concise It is imbued throughout with a mellow spirit of philosophy which will give pleasure to the professional geologist as well as to the general reader for whom it is intended No better school introduction to geology could be wished for So many small books of this kind are written by earnest amateurs who are generally ill equipped for the difficult task of writing simplified geology, that it is a pleasure to find one by a master of his subject that can be cordially recommended

Geology and Natural Resources of Colorado By Prof Russell D George (University of Colorado Semicentennial Series, 1877–1927, Vol 1) Pp xv + 228 (Boulder, Colo University of Colorado, 1927) 2 dollars

THE professor of geology in the University of Colorado has attempted to summarise a vast subject in a small volume with results that are likely to be of greater value to the geographer than the geologist Beginning with an elementary but well illustrated introduction to geology and mineralogy, the succeeding chapters deal with the geological history of Colorado , the metallic ores , fuels , structural materials , water supplies , soils and agriculture , climate and scenery The treatment is generally too sketchy to have any detailed value We learn, for example, that " the region is one of profound folding and faulting, and intrusion of igneous rocks In many places it is evident that there were at least two periods of folding and two or more periods of faulting The igneous intrusions are also of different ages " This information cannot be said to be helpful

The addition of a bibliography would have made the book really useful to geologists, and it is no excuse to say, as the author does in his preface, that " a worth while bibliography would be too voluminous " As it is, the book is likely to be appreciated only by teachers of geography in North America as a source book For that purpose it is well arranged and illustrated

Leçons sur quelques équations fonctionnelles avec des applications à divers problèmes d'analyse et de physique mathématique Par Prof Émile Picard Rédigées par Eugène Blanc (Cahiers scientifiques, publiés sous la direction de Gaston Julia, Fascicule 3) Pp v + 187 (Paris Gauthier Villars et Cie, 1928) 40 francs

THE book under notice constitutes a valuable addition to the scanty literature of the calculus of functions, so called by de Morgan Chap i deals with the functional equations forming the basis of proofs of the parallelogram of forces, with extensions to non-Euclidean statics, trigonometry and geometry Chap ii treats of the functional equations expressing rational addition and multiplication theorems of uniform functions, with applications to elliptic functions and to Poincaré's transcendents Chap iii deals with the canonical difference equation of the first order, with applications to doubly periodic functions of the first and second kinds and to Picard's transcendents The last chapter brings a discussion of the functional equations of Abel and of Schröder, and concludes with an application of Fredholm's equation to the problem of Dirichlet for the potential of C Neumann As might be expected from such a master of his craft, M Picard has treated a variety of difficult problems in a most elegant and stimulating manner, thus demonstrating the great power of methods based on functional equations, and his book can be highly recommended to all interested in this subject

Calculations in Physical Chemistry By Prof J R Partington and S K Tweedy Pp viii + 152 (London, Glasgow and Bombay Blackie and Son, Ltd , 1928) 7*s* 6*d* net

THE problems selected by the authors are of the standard required for a degree in honours, and are based from the beginning on the use of the calculus The six sections of the book deal with thermodynamics, characteristic equations, liquids and solutions, equilibrium, electrochemistry, and the heat theorem Explanatory introductions are supplied to each section, and the answers to the problems are given at the end of the book There is also a series of 100 miscellaneous exercises to which no answers are given The book should prove of real value to those who wish to acquire a mastery of physical chemistry in its numerical aspects, and, in spite of its small size, the price is not excessive in view of the compact character of the contents

Soil Management By Prof Firman E Bear (The Wiley Agricultural Series) Second edition, thoroughly revised and enlarged Pp v + 412 (New York John Wiley and Sons, Inc , London Chapman and Hall, Ltd , 1927) 17*s* 6*d* net

THIS volume is primarily intended as a book for students, not only for those in college, but also for others who desire to gain an insight into modern methods of dealing with the various problems of soil management Its general usefulness is testified to by the fact that a second edition is called for after three years The requirements of crops and the characteristics of soils are outlined at the start, but the bulk of the work is devoted to a consideration of soil resources from the aspect of utilisation and conservation, together with the best methods of supplementing the natural supplies by fertilisers Selected references bearing closely on the text are provided, together with a certain number of illustrations and diagrams

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Fluorescence of Mercury Vapour under Low Excitation.

IN earlier letters to NATURE (Aug. 18 and Nov. 10, 1928), I have described mercury fluorescence with exciting wave-length as long as λ3125. Since then even longer waves have been used. The source was a nickel arc, with a filter of natural (ortho) salicylic acid, which cuts off completely all waves shorter than 3360. The mercury vapour was at high density. The spectrum observed consists of the two well-known broad continuous maxima, one in the visual region (green fluorescence), and the other in the ultra-violet, from about 3130 to 3650. The latter has never, so to speak, been dissected. If it has appeared at all in any spectrum it has appeared complete, and it has never shown any signs of resolution into a fine structure.

It was of interest to see what would happen in the present case when excitation is applied near the middle of this band. The result is that it still apparently resists dismemberment, even in these trying circumstances: the whole of it is excited with a striking violation of Stokes's law. The continuous fluorescent spectrum extends as much as 300 A. beyond the limit of the exciting spectrum, as set by the sharp cut of the filter. Owing to stray light from the source, the fluorescent spectrum is only seen quite detached beyond this limit, and it is hard to say whether any discontinuity of intensity sets in at the beginning of the 'anti-Stokes' region.

RAYLEIGH.

Terling Place,
Chelmsford, Jan. 10.

Light-scattering and the Hydrogen Spectrum.

IN an important paper in the *Proceedings of the Royal Society* for January, Raman and Krishnan give an account of their researches on the production of new radiations by light-scattering. In 1928 they announced the discovery that when a transparent medium is irradiated by monochromatic light the radiations scattered by the molecules contain spectral lines of modified frequencies. The *difference* between the incident and the scattered frequencies corresponds to a characteristic infra-red frequency of the molecule. Such new lines are clearly shown in the beautiful spectrograms which illustrate their paper. The authors direct attention to the usefulness of this phenomenon as a substitute for infra-red spectroscopy.

The secondary spectrum of hydrogen contains many thousands of lines, of which only a small proportion has been classified. I wish to suggest the view that many of these lines arise in the way described by Raman and Krishnan, in conformity with the theoretical work of Smekal and others. When hydrogen gas is subjected to an electric discharge, the lines of the Balmer series are emitted by atoms of hydrogen, and the neighbouring molecules of gas must be subjected to bombardment by light-quanta of corresponding frequency. Hence we should expect *each* Balmer line to be accompanied by a system of fainter lines, corresponding to molecular frequencies in the infra-red. The accompanying table shows some of the first results of an examination of the secondary spectrum in the neighbourhood of the five Balmer lines $H\alpha$ to $H\epsilon$. The wave-numbers of these lines are given at the top of the table. In the lower part of the table are the wave-numbers and intensities of certain lines recorded by Gale, Monk, and Lee. The numbers in bold type are differences between such wave-numbers and the wave-number of the nearest Balmer line.

H_α	H_β	H_γ	H_δ	H_ϵ
15233·22	20564·79	23032·54	24373·06	25181·34
15102·10 (1)	20436·09 (1)	22903·51 (0)	24242·95 (1)	
131·12	**128·70**	**129·03**	**130·11**	
14970·53 (2)	20302·96 (3)	22770·26 (0)	24111·46 (2)	24919·57 (0)
262·69	**261·83**	**262·28**	**261·60**	**261·74**
14842·77 (oa)	20174·02 (1)	22643·75 (3)	23982·31 (2)	24790·49 (0)
390·45	**390·77**	**388·79**	**390·75**	**390·85**
14709·75 (oo)		22509·10 (2)		24657·74 (0)
523·47		**523·44**		**523·60**

It will be seen that these differences are approximately constant in each horizontal row, and are not far from the series of numbers 130, 260, 390, 520. In pure rotation spectra in the far infra-red the bands consist of a series of equidistant lines at intervals of $h/4\pi^2Ic$, where I is the moment of inertia of the molecule. Assuming that the lines represent a rotation spectrum, the B constant of the spectrum, which is defined by $h/8\pi^2Ic$, would be roughly equal to 65 cm.$^{-1}$ My fellow-worker, Ian Sandeman, who discussed the Fulcher bands of hydrogen at the Royal Society of Edinburgh on Jan. 7, finds $B'' = 33·39$ for this system, a value only one half the above. This led me to search for intermediate lines in the rotation spectrum, resulting in the discovery of most of the remaining members. The first member, however, instead of appearing at 65 cm.$^{-1}$, is displaced and is found at 70 cm.$^{-1}$ It should be mentioned that in many cases lines are observed having a frequency *exceeding* the frequency of the exciting line by the appropriate infra-red frequency.

There are indications that in addition to the pure rotation spectrum described, there are lines due to vibration-rotation spectra. These are at present being investigated. The claim made by Raman and Krishnan that light-scattering serves as a powerful, convenient, and accurate method of exploring molecular spectra seems to be fully justified. It appears probable that it will be of the greatest service in disentangling the complex structure of the 'many-lined' spectrum of hydrogen.

H. S. ALLEN.

The University,
St. Andrews, Jan. 10.

Variation of Latitude with the Moon's Position.

RECENT investigations at this laboratory have suggested a possible connexion between the variation in latitude of a given place on the earth's surface and the position of the moon in the sky at the time observations for latitude are made. An analysis of the whole series of the latitude observations which were made by Ross at Gaithersburg from 1911 to 1914, has revealed a striking correlation between the moon's hour angle and the value of the latitude obtained. The data were restricted to results obtained with the photographic zenith telescope, thus eliminating all personal equation. For convenience the observations were divided into two periods, one from 1911 to 1913, the other from 1913 to 1914. According to Ross's estimates, the 1913 to 1914 observations were considerably superior to those of the earlier years, as is evidenced by the smaller probable error.

In conducting the analysis a card catalogue was made of the results of the observations of latitude for each night and each group of stars. The mean right ascensions of the group give the necessary data for ascertaining the moon's hour angle at the time of

observation From the mean curve of latitude variation at Gaithersburg, extending over the period 1911 to 1914 and published by Ross, corrections were obtained to reduce each night's data to the mean latitude of Gaithersburg, determined from the observations of the whole period The resultant values of latitude were then tabulated against the mean value of the moon's hour angle for each group of stars, and the

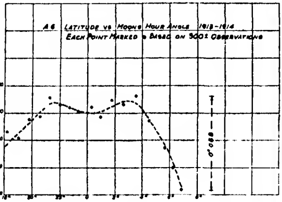

FIG 1

running mean, taking three at a time, gave the results graphically shown in Fig 1

Since the declination of the moon, and hence the observer's distance from the sub lunar point may vary greatly even for the same values of the hour angles, the hour angle and declination were transformed into altitudes and bearings by suitable tables Again, the observations were divided into two series, one including those made when the moon was above the horizon, and the other when it was below the horizon

The striking rise in the value of the latitude with the increasing altitude of the moon is shown strikingly in the altitude latitude curve, Fig 2, which again was plotted from the running means The maximum latitude occurs at altitude 30°, or when the observer was 60° from the sub lunar point It should be stated that the extreme range of variation of latitude due

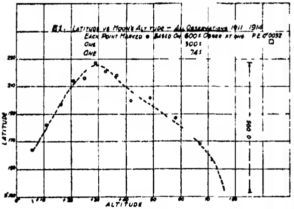

FIG 2

to this lunar effect was 0 08″ for the 1913-1914 series and about 0 09″ for the whole series 1911-1914 On account of the relatively greater degree of precision obtained in the 1913-14 series and the larger number of observations included, double weight was given this series in plotting the final graph as exhibited in Fig 2 The fact that the total variation is about twenty times the probable error for each point on the curves leaves little ground for interpreting the curve as a chance phenomenon The curve of observations for the moon below the horizon is radically different A marked fall in the value of latitude follows the negative altitude of 30°

In seeking an explanation for this extraordinary relationship, one is at a loss to account for the fluctuation on the grounds of any deflection of the vertical due to a theoretical tide in the earth's crust

Meteorological causes, unless a function of the lunar hour angle, should have been practically eliminated in the averaging of between two and three thousand observations The possibility, however, of the effect of an atmospheric tide may need some consideration It should be noted that a change in refraction systematically introduced by the passing of an atmospheric tide is of the correct sign for the observed effect, but the magnitude of the variation seems too large to be accounted for on such a hypothesis

One is led to interpret the result as a change in the

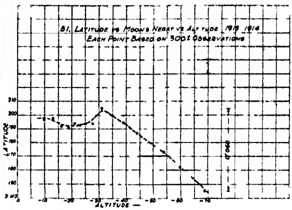

FIG 3

direction of the earth's instantaneous axis of rotation unless the more fanciful hypothesis of an actual displacement of the earth's crust is to be entertained It is to be emphasised that various attempts to detect deflections in the direction of gravity by the plumb line, horizontal pendulum or a pipe experiment such as that of Michelson and Gale, refer all changes to the positions of the earth's crust, whereas the location of the zenith as in the Talcott method for latitude determination refers the vertical to the direction of the earth's axis in space

Whatever may be the causes involved, the importance of the consequences of such an observed effect scarcely needs to be emphasised, as it vitally concerns the fundamental determination of star positions It is suggested that a possible explanation of the notable discrepancies in stellar co ordinates from star catalogues of widely distributed observatories may, at least in part, be traceable to this lunar effect

The investigation is now being continued in an analysis of the latitude observations made with the same instrument after its removal to the Naval Observatory at Washington This latter investigation has now so far progressed as completely to confirm the correlation of the change in latitude with the lunar hour angle discovered in the Gaithersburg series of observations In the preparation of the data for the analysis I have had the invaluable assistance of Miss Margaret Olmsted

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Structure of Pearls

THE origin of pearls has been a subject of speculation of both laymen and men of science alike. In the literature on this subject, one finds that most of the scientific work has been done on pearls of commercial value, such as those from *Margaritifera vulgaris*, *M. margaritifera*, and *Mytilus edulis*, and that those from other molluscs, like *Pinna*, have been studied only by a few workers. Réaumur (*Mémoires de l'Académie des Sciences*, 1717) stated that shell extrusions were the causes of pearl formations in *Pinna*. Raphaël Dubois (*Annales de l'Université de Lyon*, Fasc. 29, 1909) on *Pinna* pearls states, "Je n'ai jusqu'à présent jamais rencontré dans le noyau des perles de *Pinna* rien qui ressemblât à un Distome ou à un Ver quelconque. Mais, dans deux exemplaires, dont un est né dans le parc du laboratoire j'ai vu très nettement de petits corpuscules ovoïdes, de

FIG. 1

1 centième de millimètre, dans l'intérieur du noyau ; ils étaient semblables à ceux que j'ai signalés dans les perles de Pintadines du Golfe de Gabès et dans les perles de Modioles de la même localité. Je les considère comme des *spores de sporozoaires*."

Thirty two pearls from the tissues of a *Pinna*, dredged in the Salcombe Estuary in February 1928, were kept in Dubosq Bouin for about nine months to dissolve the calcium carbonate and to fix any soft organic matter that may be present. All the specimens were dehydrated, cleared, and sectioned by the usual method; four of these could not be completely sectioned as the nucleus fell out in the process. The sections were stained either in iron hæmatoxylin and eosin or in water blue and safranin. From the work of Alverdes (*Zeitschr. wiss. Zool.*, Bd. 105, 1913), it is known that water blue stains the conchyolin of the nacreous layer, and safranin the periostracum.

On microscopic examination, sections of twenty pearls showed that there were few concentric conchyolin bands in which the supporting organic matrix was radiating out in a manner similar to that found in the shell of *Pinna* as shown by Biedermann (*Jenaische Zeitschr. f. Naturwiss.*, Bd. 36, 1902, Taf. 1, Fig. 5), the arrangement of the layers in seven other pearls showed that it was identical with that found in 'white' pearls of *Ostrea edulis*, except that there were no discontinuous layers of brown horny material; one pearl had an alveolar layer round the nucleus, with the normal arrangement of concentric layers on the periphery, as shown in Fig. 1, and still another had an alveolar layer on the outside, added to the two layers already present as described in the previous one.

It was also observed that one pearl had small ovoid corpuscles in the nucleus, probably similar to those found by Dubois (*loc. cit.*); one had a network of conchyolin which stained blue, indicating that before decalcification there was a piece of nacreous material; eight had an irregular mass of conchyolin, the remnant of an amorphous layer; twenty one had brown conchyolin which was not acted upon by either of the stains, and finally, the nucleus of one could not be ascertained. Thus it would appear that in *Pinna*, the origin of pearls is due to abnormal secretion of the epidermis, a view similar to that enunciated by Jameson (*Proc. Zoo. Soc.* 1912) for the Ceylon pearl oyster.

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The Methodology of the Inexact Sciences

ON the rare occasions when I dip into some book on one of the non-quantitative sciences such as those which deal with folk-lore, analysis of literary documents, or the human unconscious, I am puzzled and a little scandalised by a canon of logic which appears to be very freely adopted in those branches of thought. It consists in the use of the following argument: 'It is possible to work out an analogy between *A* and *B*. Therefore *A* must be the cause of *B*, or *vice versa*." This canon used to be used very freely in the interpretation of sacred writings, and especially of prophecy, but it seems now to have passed over intact into the sciences I have mentioned above.

To give one example: in the very interesting article on "Christmas Customs and their Origins" in NATURE of Dec. 22 it was stated that "the Cave of Mithra survives in the cult of the Manger" of Bethlehem. The reason implied for this attribution is that there are two analogies between the two cults—(1) That both relate to events which took place indoors (any event must take place either indoors or out of doors, so that the coincidence is not a very surprising one); and (2) that in both cults animals are represented. It happens that the Mithraic animals—the snake, bull, scorpion, and dog—are different from those found in the stable, but in any case amongst agricultural people animals are so ubiquitous that there seems to be nothing very remarkable in the fact of their presence. This, then, is the argument: 'In Mithraism and in the Catholic Crèche you have (1) an indoor transaction, and (2) animals present (although of different species and characters); hence the cult of the manger is a survival of Mithraism.'

Arguments of this type constantly recur in the non-quantitative sciences—notably in the phallic interpretation of dream symbols. They appear to me to be fallacious, for the reason that *it is almost always possible to trace an elaborate analogy between any two groups of events whatever, chosen at random*. Any biography can be used to interpret any dream. Freud's "Gradiva" affords an outstanding example of this fact.

There is, of course, no harm whatever in the innocent pursuit of tracing such analogies, but it seems extremely misleading to apply the same term,

'science,' to those studies which employ the method freely, as to other studies in which quantitative measurement or statistics play a part and in which objective verification is practicable Would it not be preferable to coin some other term to denote the former—a suitable one could surely be found in the writings of Philo of Alexandria, who excelled in the method of research under discussion

C W HUME

14 The Hawthorns
Finchley, London, N 3,
Dec 31

I HASTEN to reassure Capt Hume No right minded anthropologist would regard the argument framed by him as scientific A science need not be judged by its camp followers and aberrant devotees Mathematical demonstration is possible only in proportion to the degree of abstraction The criterion of proof in each science depends upon the character of its subject matter and the potentialities of the methods which that subject matter admits To estimate the conclusiveness of a proof, apart from the general rules of logic, in any given subject must therefore, to a considerable extent depend upon knowledge and training Capt Hume's example is not well chosen The connexion between Christianity and Mithraism, as well as other forms of paganism, is dependent not upon one or two resemblances which might be fortuitous, but upon a series of similarities sufficiently close to warrant their being regarded as identities quite apart from the admission of the early Christian Church that borrowing and assimilation had taken place

THE WRITER OF THE ARTICLE

Blue Rock Salt

IT was suggested by Prof Baly that the blue colour of certain specimens of rock salt from Stassfurt might be explained by a difference in energy content between the blue and the ordinary colourless salt, and that this difference might be manifested by a difference in the heats of solution of the two varieties

That there must be a higher energy content in the blue form was shown by heating some of the blue product to about 350° C in an electric muffle in a dark room A distinct glow was observed soon after dropping a blue crystal on the floor of the muffle, and after the glow ceased it was found that the blue colour had disappeared without disintegration of the crystal Colourless portions of rock salt, taken from different parts of the same sample, showed either no glow at 350° C or only the faintest trace, which was probably due to the presence of a few specks of blue salt enclosed in the white

No light was emitted on dissolving blue salt in water, nor could any radiation be detected by a panchromatic plate

Several series of experiments were carried out on the relative heats of solution of the blue and colourless salt, in an adiabatic calorimeter, and by using the same range on the Beckmann thermometer throughout each series, any error due to scale inaccuracy was eliminated These experiments resulted in a difference of only about 0 5 per cent, the blue portions having a smaller negative heat of solution, as was to be expected This corresponds to a difference of only two thousandths of a degree between the falls in temperature on solution of the blue and white portions under the best conditions that could be attained

Experiments were also carried out on the relative heats of solution of purified sodium chloride and of specimens of blue salt prepared by means of cathode rays, in the hope that a larger difference in the heats of solution might be obtained than in the case of the natural product The difference was now found to be 1 5 per cent, but this cannot be directly compared with that obtained in the case of the Stassfurt halite, because the artificially prepared blue salt was found to give an alkaline solution, whereas the natural variety gives a neutral one This points to a liberation of heat due to a reaction between metallic sodium and water, and it is therefore not justifiable to rely on the heat of solution as a measure of the energy associated with the coloured state in the case of the artificially prepared blue salt

Whilst the investigation shows that there is a very slightly greater energy content in the coloured than in the colourless halite, the difference was found to be too small for accurate determination

(During the preparation of pure sodium chloride it was observed that by fusing it in a platinum vessel in air, a product was obtained which invariably gave an alkaline solution This is contrary to statements in the literature, and the matter is being further investigated both for sodium chloride and other similar compounds The results will be published in a separate communication)

F C GUTHRIE

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Newly Discovered Superconductors

AT the Glasgow meeting in September last of the British Association, I read a paper on investigations on superconductors which I am carrying out in the cryogenic laboratory, Leyden, in co operation with Prof van Aubel of Ghent, and Mr J Voogd, of Leyden In my opinion, the superconductivity of the metals is not only connected with the electron configuration in the atoms, but also with the atomic weight and perhaps with the zero point energy (*vide* W J de Haas, *Journal de Physique*, **9**, 9, 1928) From this point of view the following investigations may be interesting

Recently we have investigated not only pure metals, but also combinations of two metals in relation to superconductivity First, combinations of a superconducting metal with a non superconducting one, namely copper, silver and antimony with the superconducting tin, bismuth with the superconducting thallium The combinations of antimony with tin and of bismuth with thallium become superconductors The resistance of Ag_3Sn diminishes continually from about 3 4° abs to 1 3° abs, without vanishing, however (The resistance of the 'classical' superconductors diminishes within a temperature interval of $\frac{1}{10}$° to $\frac{1}{10}$° from a measurable to an unmeasurable value) Perhaps this combination represents a transition case, as the combination of copper with tin (Cu_3Sn) does not become superconducting

I formed the opinion, however, that combinations of two non superconducting metals could also form a superconductor The atomic weights of the metals considered are copper, 63 57, silver, 107 88, tin, 118 7, antimony, 120 2, gold, 197 2, mercury, 200 6, thallium, 204 0, lead, 207 2, bismuth, 208 The eutectic alloy of gold–bismuth was chosen As to their atomic weights, these two metals lie just below and just above the group of the heavy superconductors respectively (The numbers of the electrons in the outer layers for gold, mercury, thallium, lead, bismuth, are 1, 2, 3, 4, 5 respectively)

Again, in co operation with Prof van Aubel, who had prepared the samples, and with Mr Voogd, the resistance-temperature curve was determined The combination gold–bismuth really becomes superconducting The fall of the resistance is very great The

resistance, which is 0 7 of its value at room temperature at about 2 1° abs, has vanished $\frac{1}{10}$° lower The level, from which the resistance falls steeply lies about three hundred and fifty times higher than for the 'classical' superconductor mercury, and about a thousand times higher than for the 'classical' superconductor tin

Of course, it may be that superconductivity is a much more general property than has been supposed until now At 1 5° abs, however, neither gold nor bismuth is a superconductor

W J DE HAAS

University of Leyden,
Dec 28

The Arc Spectrum of Chlorine

L A TURNER (*Phy Rev*, vol 27, p 397, 1926) discovered the fundamental or resonance lines of chlorine due to the transition $4M_2(M_2 \leftarrow N_1)$ De Bruin (*Amsterdam Proc*, vol 30, p 20, 1927) found a number of lines in the visible with the constant frequency difference of 530, and Laporte in a note to NATURE (vol 121, p 1021, 1928) announced the discovery by Asagoe of a set of lines between λ4700 and λ4200, which he ascribed to the transition $4M_2(N_1 \leftarrow N_2)$

In a paper to the *Indian Journal of Physics* (vol 3, p 67 1928), it has been shown that if a group of successive elements (for example, Al, Si, P , , , K) be taken, the wave numbers of the lines of the elements due to the transition $N_1 \leftarrow N_2$ increase linearly with the atomic number This enables us to predict that the lines of chlorine arising from the above transition will lie in the *infra* red, the strongest line having the wave length λ8400 The lines of chlorine which Laporte mentions cannot, therefore, be due to the transition $4M_2(N_1 \leftarrow N_2)$, but may be due to the transition $4M_2(N_1 \leftarrow O_2)$, forming the higher Rydberg sequence of the infra red lines Using a special kind of chlorine tube, I have been able to photograph these infra red lines on a neocyanine plate The lines lie exactly where they were expected The quartet combinations, namely, $^4(PD)$ and $^4(PS)$, have been obtained, the $^4P_{321}$ differences being 530 and 340 The $^4(P\bar{P})$ lines lie beyond λ8700 and have not yet been obtained With this data the ionisation potential of chlorine is estimated at about 13 volts

It is interesting to note here that most of these infra red lines seem to be identical with some of the unidentified lines in the solar spectrum as given in the "Revision of Rowland's Preliminary Table of Solar Spectrum Wave lengths" by the staff of the Mount Wilson Solar Observatory Infra red lines of sulphur have been traced in the sun by Meissner (*Phys Zeit*, vol 15, p 668, 1914), but the corresponding argon lines are clearly absent Chlorine lines seem to be present It may not be impossible that, like the helium lines, these infra red lines of elements from silicon to argon may come out strongly in the spectrum of the solar chromosphere

K MAJUMDAR

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Nov 25

Salmon Disease

I AM particularly interested in the reference to the work of Dr F H A Clayton and Miss Isobel J F Williamson on salmon disease which appeared in NATURE of Dec 29, 1928

As Dr Clayton refers in his concluding remarks to the possibility of the existence of 'carriers' spreading salmon disease, the following note on the occurrence of this disease among coarse fish may be of interest to readers of NATURE

In 1914 and 1915 this disease was very prevalent locally among gold fish both in private aquaria and in the laboratory stock It also assumed epidemic intensity among roach in a private ornamental pond The occurrence of this disease among coarse fish so well removed from any stream or contact with salmon was of considerable interest An investigation was made and the results reported to the Board in 1915, from this report the following conclusions are quoted

(1) That coarse fish are subject to a bacterial disease which resembles in many respects that occurring among salmon

(2) That this disease, or a disease producing similar pathogenic conditions, occurs fairly commonly among coarse fish both in aquaria and in relatively open situations where salmon and similar fish do not occur

(3) The great similarity between the diseases found attacking coarse fish and salmon, and also between the organisms isolated, suggests that it is one disease fairly frequent among coarse fish generally and that occasionally it attains a marked virulence among salmon and is then known as the salmon disease '

Since this investigation was made the disease has not been so prevalent and the laboratory stock has been relatively free, but roach taken from a local lake in May last were infected with this disease It would appear, therefore, that the disease is endemic among coarse fish, where it may attain epidemic virulence as in the 1914–1915 outbreak, and that coarse fish may readily provide the necessary 'carriers'

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The Average Life Period of an Atom

I QUITE agree with Dr Jeffreys (NATURE, Jan 19, p 87) that a reader of my original letter would not have gathered much about Dr Jeffreys' views on earth history from my remarks about the average life period of an atom The whole point of my letter was that as the earth at present appears to be approximately in thermal equilibrium, the life period of a terrestrial atom must be very large compared with that of the universe Dr Jeffreys contention that 13 per cent approximately of the present heat loss must, of necessity, be attributed to primeval heat leaving only 87 per cent to be explained by all atomic disintegration processes, known or unknown, only strengthens this proposition

Personally, I am not prepared to accept Dr Jeffreys' view that the equation of heat conduction in a solid material is sufficient to determine the whole past and future history of the earth's crust At certain epochs in that history it is possible that we may be confronted with the problem of a liquid substratum overlain by its own solid In considering the probable history of such a case, it would appear not to be sufficient to consider the heat flow due to conduction in the upper solid alone The transference of heat in the liquid layer by convection and the physical properties of the liquid must also be taken into account

Readers interested in this problem might consult two papers by Dr Joly and Dr Jeffreys in the *Philosophical Magazine* for January 1928, and one by Dr H H Poole and myself in the same periodical for March 1928

J H J POOLE

Trinity College, Dublin

Astrophysics and the 200-inch Telescope

DURING the past few years, NATURE has published from time to time supplements containing the views of some of our leading astronomers and physicists on problems of the structure and history of the physical universe These supplements have aroused widespread interest, and the progress which has lately been made, and is still going on, in physical astronomy is probably the most significant aspect of the scientific developments of our time We may perhaps be pardoned for a feeling of pride that in Great Britain we possess some of the most brilliant workers in this field, whose labours have largely determined the direction of inquiry and inspired the forward march It is a matter of intense satisfaction that we are second to none in the quality and extent of contributions to knowledge of the universe and its laws, and there is every prospect that the position which British astrophysicists have won will be well maintained in the years to come

Of all inquiries, however, the study of the universe is the one in which an insistence on national boundaries is least appropriate If British theoretical workers were asked to what they chiefly attribute the present progress they would undoubtedly reply to the results achieved by the 100 inch telescope at Mount Wilson Since that famous instrument was installed, not more than ten years ago, the new facts, of the utmost importance, which it has been the means of revealing, can scarcely be appreciated in their entirety and full significance There is scarcely an advance in theoretical knowledge during that time that does not owe something, directly or indirectly, to the unrivalled light grasping power and resolving power of this chief among telescopes Every advance in knowledge depends in the last resort on an improvement in means of observation, and behind every legitimate theory of the universe is a collection of photographs of fields of stars

The proposal of the California Institute of Technology to erect a 200 inch telescope, to which we directed attention in NATURE of Nov 3, is therefore a project of which it is scarcely possible to exaggerate the importance We have received further particulars of this great undertaking from which it appears that the construction of the telescope itself is but one item in a scheme of wider scope It is proposed to establish a new observatory consisting of two parts "One of these will comprise the 200 inch telescope, with its building, dome, and auxiliary equipment to be erected on the most favourable high altitude site that can be found within effective working distance of the associated groups of investigators and their extensive scientific equipment The other will be an Astrophysical Laboratory on the campus of the California Institute This Laboratory will serve as the headquarters in Pasadena of the Observatory staff and the Graduate School of Astrophysics Its equipment will include instruments and apparatus for the measurement of photographs, the reduction and discussion of observations, and for such astrophysical investigations as can be made there to the best advantage Its instruments for the interpretation of astrophysical phenomena will be designed to supplement those of the laboratories of the Institute and the Pasadena laboratory of the Mount Wilson Observatory It will also include an optical shop, but the astrophysical instrument shop will be housed in a separate building, to avoid the effects of the vibration of machine tools"

The promoters of this far reaching scheme approach the problem in a broad minded manner which augurs well for its success "In the operation of the telescope," the statement continues, "the same policy will be maintained which has been followed in the past at the California Institute and the Mount Wilson Observatory of inviting eminent authorities in astronomical and astrophysical research to use the instrument in connection with their investigations It is hoped that in this way the Astrophysical Observatory will also become an international centre for research"

It is impossible to foresee what further knowledge may come to light if the proposal becomes an accomplished fact the most important revelations are probably beyond our present powers of anticipation No one could have foretold that Lord Rosse's great reflector would have revealed the spiral character of the extra galactic nebulæ, or that the 100 inch telescope would have given us their distances and fine structure A fairly well defined preliminary programme of research has nevertheless been drawn up "The increased light collecting power of the 200 inch telescope should permit further studies of the size and structure of the galactic system, the distance, radiation, and evolution of stars, the spectra of the brighter stars under very high dispersion, the distance and nature of spiral nebulæ, and many phenomena bearing directly on the constitution of matter The possibility that a 40 foot Michelson stellar interferometer, designed to rotate in position angle, may be attached to the telescope is under consideration The measurement of the separation of the components of any spectroscopic binary stars within the range of such an instrument would give very complete information regarding the nature of these systems and the masses of their components"

The chief difficulty in the matter is of course the construction of the large mirror, and it remains to be seen whether the confidence of the promoters will be justified A 22 inch disc of fused silica is already being experimented on It is proposed to coat it with a layer of bubble free silica, and afterwards to repeat the experiment with a 60 inch disc, which would be used as one of the minor mirrors of the telescope If this proves to be satisfactory, a still larger disc will be made before the casting of the 200 inch disc is attempted It is intended to employ the exceptionally small focal ratio of 3 3 for the 200-inch mirror "The field of sharp definition in the principal focus of such a

mirror will be small, but the possibility of photographing extremely faint stars, especially in the spiral nebulæ, makes such a powerful concentration of light highly advantageous Dr Ross, who will devote himself to these optical problems during the coming year, also believes that a lens can be designed, for use in the converging beam, which will serve when desired to give a much larger field, also with a short equivalent focal length It is planned to use a Cassegrainian combination with a ratio of F 10, having a sharp field 30′ (17 inches) in diameter, for spectrographic and other work A Coudé arrangement similar to that of the 100 inch Hooker telescope, permitting the images of celestial objects to be formed in a constant temperature laboratory, for study with large fixed spectrographs, radiometers, or other auxiliary instruments, is also projected "

The device of overcoming the difficulties of casting so large a disc by making only the surface layer of homogeneous material recalls a somewhat similar idea put forward by Sir Norman Lockyer so long ago as the year 1884 He proposed the construction of an 8 foot reflector, of which the body of the mirror was to be of porcelain and the surface of glass At that time astronomical photography was in its infancy, and Lockyer's ideas of the work which could be done with such an instrument, revolutionary as they then were, have a very modest appearance beside the schemes now contemplated

In the matter of mounting the telescope, much additional study will be required before even a preliminary design can be adopted It is hoped that " an equatorial design of the fork type, of sufficient rigidity to carry a 40 foot interferometer and meet other severe requirements, will soon be worked out "

In selecting a site for the instrument, precise measures of the 'seeing' rather than estimates have been aimed at Dr Anderson has devised " a simple means of measuring the atmospheric oscillations of star images under a power of 600 with a 4 or 5 inch telescope, and Mr Ellerman has tested it satisfactorily on Mount Wilson, in comparison with the estimates of experienced observers with the 60 inch and 100 inch telescopes Preliminary observations with this method by Messrs Ellerman and Humason have been made at Palomar Mountain and 'Horse Flats' (north of Mount Wilson), and some tests made by Dr Abbot and Mr Moore at Table Mountain show that this site, like the others, deserves careful examination Dr Hubble, with the kind co operation of the authorities of the Grand Canyon National Park, is engaged in the investigation of conditions near the Grand Canyon and at other points on the high plateau area of Central and Northern Arizona "

The thoroughness which is evident in this part of the plan is characteristic of the whole Not only the installation of the great telescope itself, but also the arrangements for all the auxiliary instruments and apparatus used to receive, record, and interpret the celestial images, are being subjected to a searching inquiry by an army of the greatest experts in the United States If determination, skill, and energy can bring the plan to a triumphant issue, it is assured of success We trust that the practical difficulties of so enormous an undertaking will not prove insurmountable

The Transport of Carbohydrates in the Plant

VERY little is certain as to the movements of carbohydrates in the plant It is generally agreed that the green plant can build them up for its own needs in leaves exposed to the light, and that these supplies are then utilised in growth throughout the plant, so that considerable movements of sugars must take place from the leaves to the roots and fruits and various storage organs There is no agreement, however, as to the tissue through which this movement takes place Only two tissues, regularly present in this plant axis, are so extended in the longitudinal direction as to be very likely to convey such substances for long distances through the axis, these are the wood or xylem, and the phloem or bast Usually, the sieve tubes of the phloem have been regarded as the channels of sugar transport, as micro-chemical observations, such as those of Prof Mangham, seemed to show considerable quantities of sugar in these tissues The phloem in many trees is confined to a narrow layer near the periphery, so that it is possible to cut this channel completely by removing a narrow strip of tissue from the outside of the stem, and there is evidence that such ringing experiments always interfere with carbohydrate transport Prof H H Dixon pointed out, however (NATURE, vol 110, 547 551 1922), that the xylem sap usually contains appreciable quantities of sugar, and that in the ringing experiment it is very difficult to remove the phloem without doing some damage to the wood As a result, the wood may be partially blocked, so that the interruption of the carbohydrate movement, attributed to the ringing of the phloem, may be really due to the partial choking of the xylem channels

In much of the experimental work done to elucidate this problem, the transfer of carbohydrates through the region of the axis experimented upon is gauged by the amount of growth afterwards made as the result of supplies assumed to come from sources on the other side of the ring Thus Prof Otis F Curtis has published a series of observations upon ringed shoots which were defoliated above the ring, and as a result made little growth, presumably through the failure of supplies to cross the ring In such experiments the plants have obviously to be left for some time following the original ringing operation, and though Prof Curtis has on many occasions followed up his observation of growth by quantitative analyses of his plants for carbohydrates, nitrogen, etc, it is difficult to know how much the redistribution observed has been determined by metabolic activities connected with growth, and how much it has been directly the

result of the interruption of translocation in the phloem None the less, the work of Prof Curtis has established a very strong presumption that the phloem is at least very active in the transfer of carbohydrates and probably many other substances through the axis of the plant In two recent papers by Messrs Mason and Maskell in the *Annals of Botany* (vol 42, January 1928 and July 1928), a great deal of new evidence is supplied which points in the same direction The Empire Cotton Growing Corporation has recently issued a reprint of these papers,[1] which form an outstanding contribution, based upon an intensive study of the cotton plant, to the solution of the general problem of the transport of carbohydrates in the higher plant The papers occupy together more than 120 pages, and they describe much suggestive experimental work, with critical discussion of procedure and results, for which reference must be made to the original papers

The experimental method adopted by Messrs Mason and Maskell has been to follow, by analytical methods that permitted of certain standard determinations on numerous samples in a limited time, the changes in carbohydrate content in isolated samples of leaf, wood, and bark (the latter tissue including the phloem) within periods of time usually not greater than two or three hours Sucrose, reducing sugars, and reserve carbohydrates were estimated separately, and the results expressed on the basis of the residual dry weight (total dry weight less carbohydrates) as a quantity that is less liable to fluctuation than either fresh weight or dry weight Unfortunately, at each sampling an experimental plant is sacrificed, so that large numbers of plants of one strain of Sea Island cotton were grown under as uniform cultural conditions as possible, several samples taken and analysed separately on each occasion, and statistical methods applied to the whole series of results obtained in any one experiment, so that significant correlations and differences might be determined In these experiments, therefore, any movements of carbohydrates that may be indicated will be the direct result of a fairly rapid longitudinal movement of these substances through the tissues, and not the indirect result of growth activities, which are not likely to produce very appreciable changes in such short time periods

The immediate result of the new experimental method was to establish a significant correlation between the diurnal variation in the concentration of sugars in the leaf with similar variations in the bark, but not usually in the wood At a distance some 50 cm or more below the leaf, the variation of concentrations in the bark seems to follow the same curve, but is two or three hours later in reaching similar points on the curve Reserve carbohydrates, which fluctuate greatly in the leaf, show little or no change in wood or bark, and are not considered further in the present brief discussion In experiments in March, fruit bolls were included, and samples of wood and bark lying between leaf and boll The result was to show significant correlations with similar time lag in the sugar content of leaf and bark and the dry weight increase in the developing fruit

In September and later months, the results of ringing experiments were examined by the same methods at six hourly intervals after the ring was made, with the result that above such a ring, made below the leafy region of the plant, an accumulation of sugars was soon observed in both wood and bark, whilst in the 6½ inches of wood and bark just below the ring there is a marked fall in total carbohydrates In this case correlated changes were noted in both wood and bark, and these and other experiments suggest to the investigators that an accumulation of sugars in the bark at any region is followed by a slow radial transfer of sugar into the wood in this region Other ringing experiments, however, in which flaps of bark were lifted off the wood and separated from it during experiment by paraffined paper or vaseline, showed that, provided these strips of isolated bark remained connected to the foliar region above by continuous channels in the bark, accumulation of sugar still took place in them, though they ceased in the wood in the same region

These experiments, on the whole, seem to provide very definite evidence that the major movement of carbohydrates from the synthetic centres of the leaves takes place through the phloem, though the possibility of carbohydrate movement under certain conditions in the xylem is, of course, not excluded Experiments in the second paper, in which different regions of the phloem are analysed separately, suggest that the inner region, which consists more predominantly of sieve tubes, and possibly to a large extent of developing ones, is the region in which most of the longitudinal movement takes place, because the concentration of sucrose is much higher in the inner region, so that the concentration gradient of sucrose outwards in a radial direction is 300 500 times as steep as in a longitudinal direction

Whilst Mason and Maskell have thus supplied striking experimental evidence in favour of movement of sugars through the phloem, they do not fail to point out the difficulties in the way of understanding this phenomenon Changes of sugar concentration in the leaf sap are followed by changes in the phloem of the axis, as if the concentration gradient determined the movement of sugar, as it would do in the case of movement by diffusion But from the rapidity with which these concentration changes are registered at distances of more than fifty centimetres, they calculate that the longitudinal movement of the sugar in the sieve tube is at least 20,000 times too fast to be due to diffusion of sugar through an aqueous medium Furthermore, there is another stumbling-block in the way of regarding the concentration gradient as the driving force determining movement In the leaf the variation is principally in reducing sugars, and this is followed by changes in the concentration of sucrose in the phloem They conclude,

[1] Memoirs of the Cotton Research Station Trinidad Series B, Physiology No 1 Studies on the Transport of Carbohydrates in the Cotton Plant By T G Mason and E J Maskell Empire Cotton Growing Corporation, 2 Wood Street Millbank London, S W 1 1928.

therefore, that sugar moves in the sieve tubes by a process analogous to diffusion, but that the mechanism by which such high absolute rates of movement are maintained is unknown

In this connexion the possibilities of streaming movements in the segments of the sieve tube might be worthy of further examination It is a well known fact that in many elongated living cells the protoplasm of the cell rotates within its wall at speeds which would permit of movement along the cell at rates of several centimetres an hour There is still the need of transfer from one rotating protoplast to the next on the opposite side of a cellulose wall, but the distance thus traversed by diffusion will not be more than $\frac{1}{100}$ the total distance travelled in the sieve tube This method of transfer would then result in movement, which would obey the concentration gradient, and yet be very much more rapid than diffusion in water Mason and Maskell apparently reject it because protoplasmic rotation is rarely seen in the adult sieve tube—although it has been reported by Lecomte On the other hand, in sections of young developing phloem, as in tangential longitudinal sections through the inner bark of trees, which are mounted in water, most lively streaming movements are usually visible Strasburger has also shown how readily similar movement can be seen in long cells in the phloem of herbaceous plants which were very possibly developing sieve tubes

Whilst the adult sieve tube, therefore, may act as a reservoir, which is gradually depleted by local utilisation of its contents, the streaming segment of the developing tube may be responsible for the rapid longitudinal transfer of the carbohydrates Mason and Maskell eliminated, so far as possible, the complications introduced by growth activities by cutting down the duration of their successive experiments so far as possible But the inner segment of the phloem in which the very high concentration of sucrose was observed would contain all the young sieve tubes developing from the cambium

This consideration might throw some light upon a gradient of reducing sugars in the leaf being followed by an equivalent gradient of sucrose in the phloem of the axis Any enzyme synthesis of sucrose from glucose and fructose *in vitro* has so far proved impossible, and in the light of modern knowledge of the difficulties of sucrose synthesis (Nature, Oct 13, 1928, p 578), this is quite explicable In the sieve tube it is difficult to see how the direct conversion of reducing sugar to sucrose is to be brought about, but if the reducing sugars are employed in the construction of living protoplasm, which is then utilised in the construction of a new series of sieve tubes from the cambium, in the differentiating sieve tube sucrose may be found instead of the hexoses which originally entered into the composition of the protoplasm J H Priestley

Obituary

Dr J W L Glaisher, F R S

Dr J W L Glaisher died on Dec 7, 1928, at the age of eighty years At the time of his death he was the senior among the actual fellows of Trinity College, Cambridge, was the senior member of the London Mathematical Society, and was almost the senior in standing among the fellows of the Royal Society and the fellows of the Royal Astronomical Society In his prime he ranked as one of the recognised English pure mathematicians of his generation, pursuing mainly older subjects by methods that were direct and simple Throughout his life he was devoted to astronomy, chiefly in its mathematical developments In the later part of his life he attained high rank as an authority on pottery, of which he had made a select collection, famous and invaluable

Glaisher was the elder son of James Glaisher, F R S, himself an astronomer, a mathematician specially devoted to the calculation of numerical tables, and a pioneer in meteorology, sometimes at the risk of his life For the father was an aeronaut of note, with Coxwell in 1862 he made the dangerous balloon ascent which reached the greatest height (about seven miles) ever recorded by survivors This aeronautical achievement inspired a popular music hall song of the day, and "Up in a balloon, boys," was sung by the undergraduate gallery in the Cambridge Senate House as the aeronaut's distinguished son was being admitted to his first degree

James Whitbread Lee Glaisher was born at Lewisham, in Kent, on Nov 5, 1848 He was sent to St Paul's School in London, which in 1867 he left as the Campden Exhibitioner In that year he went into residence at Trinity College, Cambridge, and that was his home for the rest of his life He was duly elected a scholar in 1868 He graduated as Second Wrangler in 1871, the Senior Wrangler being John Hopkinson, also a Trinity scholar, later the distinguished engineer He was elected a fellow of his College in that same year, the election was doubly notable, for it was the first held after the parliamentary removal of dissenters' disability of fellowship tenure, and all the three successful candidates (the other two being Hopkinson and the present Dean of Ely) were elected at their earliest date of candidature

Glaisher was appointed assistant tutor of his College on Oct 12, 1871, an office that qualified for the lay retention of his fellowship, though celibate restrictions existed for another eleven years He was tutor from 1883 until 1893, for the then customary normal period He remained a lecturer on the mathematical staff until 1910, having been continued beyond the normal maximum period by the College Council

Glaisher never held any permanent appointment outside Cambridge It was currently believed that, on Airy's retirement in 1881, he refused the office of Astronomer Royal which had been offered to him, the duty would, of course, have exacted

residence at Greenwich He remained a bachelor When first a fellow, he lived in Whewell's Court his rooms then resembled a rather cheerless set of chambers, with pigeon holes and cabinets for documents, pamphlets, notes of calculations, and bookcases for his growing library In 1885 he changed into a spacious set of rooms, with a view down the lime avenue across the river away to the Coton fields, with the change, there came a change in the appearance of his surroundings His library naturally continued to increase But he began to collect objects of beauty and rarity, in arts of several kinds Once begun, his collection never ceased to grow, always under his unlimited and unstinted care, yet his favourite working corner between the fireplace and the window, remembered by every visitor, remained his mathematical shrine of duty to the very end of his life, and, there, a jealously reserved portion of each working day in Cambridge was spent in his mathematical researches with a regularity that never failed

His personal pursuits, outside his teaching, his research, his attendances at scientific meetings, and his passion for collecting, were varied He was a vigorous walker, and covered ground at an amazing pace In his youthful donnish days he rode a bicycle of the 'penny farthing' type, his tall lean frame lending itself to the claims of that forgotten machine, and he was an active president of the Cambridge University Bicycle Club In his middle years he often went to the United States to spend vacations with his friends Prof and Mrs Woolsey Johnson and their sons, or when they crossed the Atlantic he would have them in Cambridge, or would travel with them on the Continent He maintained a wonderful vitality and a surprising appearance of comparative youth, even in his early seventies It was only in the last few years that his health gave way, and it broke badly, but the spirit remained

In 1875 Glaisher was elected a fellow of the Royal Society His first original paper, full of cognate historical matter, dealt with the non evaluable sine integral, cosine integral, and exponential integral, and contained elaborate tables of those integrals, calculated by himself, it had been written by 1870, while he still was an undergraduate, and was communicated by Cayley He served on the Council of the Society for three periods, 1883–84, 1890–2, 1917–19, during the last of which he was one of the vice presidents In 1913 he was awarded the Sylvester medal of the Society

He had joined the Royal Astronomical Society in 1871, and became a member of the Council in 1874, he remained a member of that Council for the rest of his life, and his fifty four full years of continuous membership may be a 'record,' to use a popular word of to day He held the office of secretary from 1877 until 1883 He was president of the Society in two distinct periods of office, 1886–88, and 1901–3, during those tenures, it became his duty to present the Medal of the Society to G W Hill (1887), to Auwers (1888), to Kapteyn (1902), and to Struve (1903), delivering masterly summaries of the original work of the several recipients on the respective occasions

Throughout his scientific life Glaisher devoted much attention to the affairs of the London Mathematical Society He was elected a member on Feb 8, 1872, and he became a member of the Council in the succeeding November, he retired from that body in 1906, after a continuous service between those dates He was vice president in 1880, 1881, 1886, 1887, and president in 1884–85 Thus his own experience gave him full knowledge of the development of the Society almost from its beginning At a meeting in 1926 to celebrate a belated jubilee of its existence, he gave a charmingly genial account of its activity, particularly of its early stages, and of the personal inspiration of members like Cayley, Sylvester, H J S Smith, and Clifford In that account there was one defect, characteristic of the man it ignored his own contributions to the Society's influence upon mathematical science He was awarded the De Morgan medal in 1908 There is no record of his reply of thanks on the presentation, but, as later in 1926, his words—he would have disdained to call them a speech or an address—were the expression of a friendly retrospective review of the Society, of which (so little did he say of himself) he might at the moment have been the least known member, instead of the most honoured

In early and middle years Glaisher was a frequent attendant at the annual meetings of the British Association He took an active part in its work, as secretary of Section A for a considerable period, and as a member of several committees dealing with tables of numbers, or with reports upon the progress of various branches of mathematical science He was president of Section A at the Leeds meeting in 1890 his address dealt with relations between applied mathematics and pure mathematics, at a time when it still was not unnecessary in England to plead occasionally for a fuller recognition of pure mathematics

It was a matter of course that he was a member of the Cambridge Philosophical Society He often served on its Council in various capacities, frequently contributed papers to its *Proceedings*, and was in regular demand as a referee upon papers contributed by others He was president of the Society in 1882–84

Glaisher proceeded to the newly established degree of doctor of science at Cambridge in 1887, at the time of his death he had come to be the senior in standing among his fellow doctors He was made an honorary doctor of science by Dublin on the occasion of the tercentenary celebrations of Trinity College, and, later, he received the same honorary degree from the Victoria University He was one of the British honorary fellows of the Royal Society of Edinburgh, as also of the Manchester Literary and Philosophical Society, and he was a foreign member of the National Academy of Sciences of Washington He was also president of the Cambridge Antiquarian Society in 1899–1901, an office that is uncommon for a man so actively engaged in mathematical teaching and research

and in the current administration of scientific societies (in the most restricted sense of the term) But, as already indicated, the study of pottery was one of his hobbies what began as a hobby developed into one of the absorbing interests of his life, and he became[1] " one of the leading pottery collectors of his time His attention in this direction was at first occupied by Delft ware, but from the Dutch pottery he was led to take an interest in the English wares made in emulation of it, and so in other types of English pottery of early date The collection which he had been forming through a long period of years is, as regards the 17th and early 18th centuries, the largest collection of English pottery ever made, and it is satisfactory to reflect that, by becoming the permanent possession of the Fitzwilliam Museum, in which a large part of it has already been for many years on view, it will be accessible to all who wish to study it " It may be added that he had made (and at the time of his death was still engaged in) a catalogue of his collection in nearly forty manuscript volumes, which may well prove a valuable addition to the literature of ceramics

When he was a lecturer at Trinity, Glaisher had his share of work that belonged to the ordinary round, such as astronomy or hydrostatics for the Tripos range, even a 'poll' lecture His happiest efforts were devoted to subjects such as differential equations, combination of observations, elliptic functions In each of these subjects his lectures in the late 'seventies were a revelation to students The Tripos was never mentioned the subject was expounded His exposition was the more illuminating because concurrently (though unknown to his class) he was writing paper after paper dealing with details unmentioned in the text books (if any), and enterprising students were encouraged to proceed to original sources Such lectures were an intellectual treat Then his course on combination of observations was at once critical, synthetic, constructive, he was singularly clear in setting forth assumptions made and the restrictions imposed by the assumptions But, above all, he revelled in elliptic functions It was not that he was opening unknown regions of new theories, at that date he never even mentioned the more comprehensive general theory of functions, scarcely known in Cambridge, even by title, but his results were a sheer development of Jacobi's work, the calculations being made with the ease of a controlling master Some of us who were members of his class used to believe that he had discovered all possible formulæ in elliptic functions and q series, which were being incorporated in an expected treatise in the grand style His enthusiasm was infectious, in his lectures there was a human note, something of the nature of the man, a little fun, a little whimsical touch now and then, not untypical of that geniality which marked his intercourse with fellow men

Yet Glaisher never published a volume of his own Perhaps the sheets of that treatise on elliptic functions existed only in our undergraduate imaginations, perhaps they ceased gradually when he found that much of his presentation of the subject was only an incident in the wider theory of functions Perhaps also, in the midst of his own researches, he was reluctant to devote the time and the labour that are demanded by the preparation of a continuous treatise, there is a germane passage in his presidential address to the London Mathematical Society which might be an autobiographical confession of his own hesitation in attempting such a task But when others went forward, sometimes stimulated by himself, he was ever the first and the most generous in the recognition of their labour

The tale of Glaisher's separate papers, mathematical and astronomical, was large, amounting to something like four hundred in all They were not distributed evenly over his long scientific life Thus, down to the end of 1873, when he was only twenty five years of age, he had published more than sixty papers, not all of them brief In the next ten years—with him, as with many men, the most prolific period of production—he published more than a hundred and fifty In 1883 he became tutor of Trinity, and held that busy office for the canonical period of ten years, even so, he found leisure enough to produce some fifty papers in that time, and he continued this rate of production more or less to the end, amid the growing absorption of his pottery and, even latterly, in spite of the distractions of discomfort and pain and ill health

The subjects over which his published investigations range belong to certain well defined regions Glaisher had an unfailing interest in the history of mathematics, he would range over the historical introduction of the plus and minus signs, over the work of Napier and Briggs in the construction of logarithms, to a treatment of recent changes in the Mathematical Tripos He was fascinated by sheer arithmetical computation and revelled in the construction of numerical tables, or he would be absorbed in the properties of certain numerical functions in the theory of numbers at large Weird series and extracted identities were an unfailing attraction for his mental activity Differential equations, mainly ordinary linear equations and their integration in series, absorbed much of his earlier attention In England down to his time, progress in this subject had centred in formulæ that were 'elegant', 'symbolic' solutions had been accumulated by the ingenuity of mathematicians like Leslie Ellis, Gaskin, Boole Of all this lore Glaisher was the master and, in its range, a creator Yet, wandered he never so far afield, he returned time and again to his beloved elliptic functions

Mention also must be made of the addresses Glaisher prepared, some of them official, some of them personal tributes Among the latter may be recorded his NATURE notice of Cayley, early in 1895 his biographical notice of J C Adams, prefixed to the "Scientific Papers" and the introduction to the "Collected Scientific Papers of

[1] For the following estimate, extracted from a part of the (unsigned) obituary notice of Glaisher in the *Times* of Dec 8 1928, I am indebted to Mr Bernard Rackham, of the Victoria and Albert Museum

H J S Smith" He was at his appreciative and genial best in general addresses His careful lecture, delivered in the ante chapel of Trinity in 1887, in commemoration of the bi-centenary of the publication of Newton's "Principia," was a wonderful tribute to a great spirit His address as the president of the London Mathematical Society in 1890 is a valuable monograph on the long history of the Senate House Examination, more commonly called the Mathematical Tripos, since 1824 The last of his addresses, in 1926, already quoted, may continue to stand as the best authentic history of the early stages of the London Mathematical Society.

In person Glaisher was very tall, slim all his days, with an upright figure which even his long illness could only partially bend His smile of appreciation was delightful and infectious, when appreciation waxed into admiration, his attractive eyes could glow with sympathetic delight He was singularly fluent in speech, though he never aimed at eloquence, yet dignified passages abound in his formal addresses He was a don, not of the old fashioned type, scarcely indeed of any recognised type, there was no shred of pomposity, there was a persistent note of good nature, not devoid of the occasional touch of whimsical mischief, with which he sometimes would quiz too seriously solemn persons The deeper notes of human feeling were not wanting when, as occurred to him during his tutorship, he had to help others to face issues of life and death

In mathematical science Glaisher now appears to have been a man mainly of stimulating influence upon others, and an inspiring teacher, rather than a pioneer whose manifold contributions to his science could be proclaimed as notable and memorable The earlier years of his teaching at Cambridge were a time of transition in the mathematical thought and activity of the University Cayley was almost a voice crying in the wilderness, and Glaisher himself described Cambridge pure mathematicians of those days as generals without armies When he ceased teaching, Cambridge pure mathematics had gone far beyond his active vision, mainly under men whom, as his students, he had encouraged and stimulated at the beginning His influence was rather that of the inspired preacher and herald His voice was that of a great teacher, yet not in any way similar to the great Cambridge coaches of the past, for throughout his life he was ever a contributor to the knowledge of his science as well as a guide through ranges of knowledge outside the conventional examinational learning He was a distinct personality in his day, a stimulus to other men, especially young men who came within the sphere of his influence, and he has left a name, high among the noted names of his own generation, in two widely different fields of constructive thought and human activity A R F

WE regret to announce the following deaths

Sir William Boyd Dawkins, F R S honorary professor of geology and palæontology in the Victoria University of Manchester, the doyen of students of prehistoric man on Jan 15, aged ninety one years

Dr H J H Fenton, F R S, honorary fellow of Christ's College, and formerly lecturer in chemistry in the University of Cambridge, on Jan 13, aged seventy four years

Prof Wm North Rice, emeritus professor of geology in Wesleyan University, president in 1891 of the American Society of Naturalists and a vice president in 1905 of the American Association for the Advancement of Science, on Nov 13, aged eighty three years

News and Views

THE paper by Prof A S Eddington on the charge of an electron which appears in the January issue of the *Proceedings of the Royal Society* (vol A, 122, p 358), and was read and discussed at the meeting of the Society on Jan 17, is based upon the fundamental principles of the theory of relativity and of the new mechanics The so called exclusion principle of the statistics of Fermi and Dirac prescribes an interaction of two electrons, this interaction is identified with their electric repulsion, and the details of the latter phenomenon can thus be predicted on essentially statistical grounds The problem is taken to be one of a 'space' of sixteen dimensions, and it follows that the ratio $hc/2\pi e^2$ (where h, c, and e have their usual significance of Planck's constant, the velocity of light and the electronic charge respectively) should be simply the number of symmetrical terms in an array of sixteen rows and sixteen columns, which is 136 The experimental value of the ratio is 137 1, but Prof Eddington believes that the discrepancy, although some three times the reputed probable error of experiment, does not originate with the theory Prof Eddington's conception of the meaning of the factor $2\pi e^2/hc$ can be best given in his own words It "expresses a kind of property attributed to every pair of points in space, it turns space from a mathematical conception into a possible site of physical phenomena by associating with a pair of points some degree of probability that they may be the scene of this interaction There is no room for elaborate integrations or for differential equations in the theory of such a fundamental factor" Again "Modern theory has virtually abolished all structure of an electron," and with this, the expectation "that the value of e would depend on the singular solution of some differential equation expressing the transition from charge to field"

THE issue of the *Proceedings of the Royal Society* for Dec 3 (Series A, vol 121, No A788) is especially interesting to students of quantum mechanics, it contains no less than five papers which are excellent examples of the process of consolidation going on at both ends of the new theory Any new theory, naturally enough, especially one developed at the rate of the theory of quantum mechanics, is liable to be presented at first with a lack of complete-

ness, symmetry, or elegance The lack of such elements is of course no ground for criticism, but it may prove a stumbling block to further advances or cause unnecessary difficulty to the student At the applications end of the new theory we find here papers by Temple and Nordheim—one presenting with really delightful elegance the quantum theory of the scattering of electrons by the field of force of a bare nucleus, the other completing the theory of the emission and reflection of electrons by clean metal surfaces—a theory which is proving of great help in the understanding of thermionic phenomena At the foundations end of the theory there are papers by Eddington Whittaker and Flint These all aim in different ways at expressing the principles of quantum mechanics in more general or more symmetrical ways than have yet been achieved The results obtained at this end of the theory are always harder to appreciate than those of the other end, but one cannot avoid the feeling that further steps in the development of the foundations of the theory will not be long delayed

ON Jan 28 occurs the centenary of the death of Thomas Tredgold, who, though he died at the early age of forty, yet during the last ten years of his life gave the engineering world three works of first class importance "Elementary Principles of Carpentry," an 'Essay on the Strength of Cast Iron," and a "Treatise on the Steam Engine" Though not destined to rise to the same eminence as his contemporaries Rennie Fairbairn, or Stephenson, like them he started life with no advantage of environment, and like them he possessed an untiring industry Born at Brandon Durham, on Aug 22, 1788, he received a village school education, and then at the age of fourteen was apprenticed to a cabinetmaker From 1808 until 1813 he worked as a journeyman carpenter in Scotland, from 1813 until 1823 was an assistant in the office of a relative William Atkinson, a London architect and for the last few years of his life practised as a civil engineer in London His "Principles of Carpentry," of 1830, was the first serious attempt in England to determine practically and scientifically the data of resistance, his essay on cast iron of 1824 was the earliest systematic treatise on that subject while his book on the steam engine of 1827 was used by later writers, and enjoyed a popularity equal to that of the later works of Bourne and Rankine Besides these separate works, which went through several editions, Tredgold wrote valuable articles in the "Encyclopædia Britannica," Thomson's *Annals of Philosophy*, and Tilloch's *Philosophical Magazine* He died in London and was buried in St John's Wood Chapel Cemetery

THE recent official announcement that the Government will ask Parliament for a vote of $5\frac{1}{2}$ million pounds for future forestry work in Great Britain will be regarded with satisfaction by all who realise that this matter is one of economic importance to the nation, and should stand outside of party politics The Forestry Commissioners were appointed, under the Forestry Bill of 1919, for a period of ten years, which comes to an end in April of the present year A sum of $3\frac{1}{2}$ million pounds was sanctioned for the first ten years' work The Government now intends asking Parliament to sanction the continuance of the work of the Forestry Commissioners, increasing the grant for the next two years by 2 million pounds In addition, the Commissioners anticipate receiving a total revenue from forest receipts of £1 400 000 during the next ten years With these sums they expect to provide 225 000 acres of new plantations, to devote £1 000,000 to forest workers' holdings, and to make grants for other purposes, including the planting of municipal and private lands and forestry education and research

THE ten years work of the Forestry Commissioners now coming to an end has not proceeded without some of its operations being called in question in more than one part of Great Britain This has proved rather an unfortunate aspect of the new work, since it has led to the attitude and acts of the Commissioners being regarded with suspicion by many who should have been secured as active allies From the professional point of view the forest policy of the Commission where such has been apparent is open to grave doubts The concentration for example on the formation of coniferous plantations (124,000 acres), and the total neglect of our valuable British broad leaved species (4000 acres only in the period) has been strongly criticised On the other hand, the Commission has put through a great deal of good work, and its well wishers will hope to see it continued It may be suggested however, that the House of Commons, when considering this vote should make itself acquainted with the work undertaken during the past ten years Over that work the House has had little control, since the Commission unlike all other departments of the State, is not under a Minister of the Crown

THE second annual Report of the Oxford Preservation Trust, recently issued, gives an interesting record of the past year's achievements in the way of saving many of the sites in and around Oxford from the damage done to the amenities of the city by ill considered building operations An excellent map which accompanies the report shows five several plots of country within the five mile radius which have been secured from the intrusion of the speculative builder by private benefaction and by the present Trust and its predecessor The fauna and flora of the Oxford district are well known to be of a rich and varied character, as was amply shown by the volume on the natural history of the district brought out under the editorship of Commander J J Walker at the time of the meeting of the British Association in 1926 Even then the growth of the city had done much to deprive the immediately surrounding country of its suitability for the support of wild life, but it is satisfactory to know that some compensation for the loss is to be found in the sites saved from further encroachment through the activity of the Trust In the words of Prof E G R Waters, speaking of the micro lepidoptera, "the many sheltered woods and copses, rough pastures and swampy meadows, which are the principal habitats of these delicate and local insects,

have been much reduced by the constant advance of cultivation, cattle, building, and (most destructive of all) golf links, but the remarkable concentration of lepidopterous life in some of the surviving localities partly compensates for what they have lost in extent" The reconciliation of commercial with æsthetic aims within the city itself—a still more difficult problem—is also being taken in hand by the Trust, which makes a strong appeal for pecuniary help

AT the time of writing, little is known about the strong earthquake that, at 7 24 A M on Jan 17, destroyed many buildings at Cumana, an important seaport town of Venezuela Though the damage to the town is considerable and is probably greater than the early reports indicate, the earthquake seems to have been far inferior in strength to the great shocks that destroyed the town on Oct 21, 1766, and Dec 14, 1797 The latter earthquake, which occurred nearly two years before Humboldt's visit to the country—he himself felt two of its after shocks on Nov 4, 1799—is described in his "Personal Narrative" (translated by H M Williams, vol 2, pp 214 238, vol 3, pp 316 327) The number of lives lost was 16,000, while the first official estimate for the recent earthquake places the number at 30 Humboldt notices that, both in 1766 and 1797, swellings were observed in the shoal of Morro Roxo, near the mouth of the Rio Bordones He traces the migration of the focus from the south coast of the Gulf of Cariaco in earlier years to Cumana in 1797, and attributes it to the opening of new underground communications, and remarks that the rapidity with which the undulations are propagated to great distances proves that the centre of action or focus—he was one of the earliest to use this term—is very remote from the surface of the globe

ON Jan 19 a conference was held at the John Innes Horticultural Institution, Merton Park, London, S W, to mark the hundredth anniversary of the birth of the founder, John Innes John Innes was a city merchant of an old Scottish family, who with his brother bought a considerable estate in Merton, and while living there proceeded to build what was then the pleasant and almost isolated suburb of Merton Park John Innes in his lifetime gave many examples of his generosity to his neighbours and finally left his residual property to found a school of gardening As the endowment promised to become of considerable value, the Charity Commission, in drawing up the scheme for the administration of the trust, made provision for a research station which at the same time would train practical gardeners The Institution thus founded began work in 1908, and, being fortunate to obtain the late William Bateson as its first director, became immediately identified with the then young study of genetics

THE conference on Saturday last dealt with various aspects of polyploidy, as a source of species and horticultural varieties After Mr J B S Haldane, for the benefit of the non technical part of the audience, had explained what a polyploid was, Dr C C Hurst illustrated by reference to the genus *Rosa* how cytology discriminates between species and varieties Prof E W MacBride objected that such distinctions are unknown among animals Prof Ruggles Gates discussed the origin of polyploids, and the variation of the size of the cells with polyploidy, but, as he and other speakers pointed out, it is difficult to make any generalisation that will cover all the cases Dr C D Darlington discussed the pairing of the chromosomes in polyploids, and Mr J B S Haldane, in explaining the laws of inheritance in polyploids, showed that their structure involves such a complexity of combinations that the chance of fixing a particular variation is greatly reduced as compared with diploids Dr C L Huskins dealt with polyploidy in cereals, where such important groups as the bread wheats and ordinary oats are hexaploids Mr M B Crane gave some remarks on polyploidy in *Prunus* and *Rubus* preparatory to a demonstration of some of the seedlings that have been raised at Merton Miss Pellow demonstrated polyploidy in *Primula kewensis*, and Dr F W Sansome some of the tetraploid tomatoes that can be produced vegetatively

SIR WILLIAM BRAGG described recent progress in crystal analysis in his discourse delivered at the Royal Institution on Friday, Jan 18 Discussing the use of X rays in revealing the structure of solids, Sir William dealt with the results which have followed their application to the examination of alloys In pure copper the atoms are piled together in close packing, like spherical shot, each sphere then touches twelve neighbours When a small number of zinc atoms are added, they distribute themselves at random amongst the copper atoms without disarranging the pattern very much But there is a limit to this addition If too much zinc is put in a new pattern is formed, in which each atom now has only eight neighbours As more zinc still is put with the copper, a very complicated pattern is formed the unit of which is twenty seven times as large as in the preceding case, and there are fifty two atoms in it, this alloy is very hard and brittle Curiously enough, there is an alloy of copper with aluminium, and again of copper with tin, in which the same properties are exhibited, the same pattern is found, and the same number of atoms in the pattern moreover, there is the same number of free electrons These curious alloys are composed of five atoms of copper to eight of zinc, nine of copper to four of aluminium and the third very approximately in the ratio of thirty one of copper to eight of tin In each case there are thirteen atoms to twenty one electrons These new and interesting results are due mainly to the work of Owen and Preston, Bradley, and Bernal in England, Westgren and Phragmén in Sweden They open up new ideas of the conditions in the alloy They suggest that we ought not merely to think of an alloy as a mixture of atoms, but in some cases at least as a mixture of electrons with atoms, the latter having considerable latitude as to nature

IN his presidential address, delivered on Jan 16 to the Royal Meteorological Society, on "Amateurs as

Pioneers," Sir Richard Gregory stated that until relatively recent times all scientific societies were organisations of amateurs At a later stage, when their inquiries became of practical value, professional institutions are established, and much of the work is taken over by industrial or national services In the middle of last century, James Glaisher formed an organisation of voluntary observers for meteorological records, and the Royal Meteorological Society maintained this service until it was taken over by the Meteorological Office in 1912 The systematic collection of rainfall records, which was started by G J Symons in 1859, has similarly become part of the organised work of the Meteorological Office The systematic study of upper air conditions, now carried on for practical purposes of aviation, originated with W H Dines and C J P Cave It was an amateur, Benjamin Franklin, who established the identity between the discharge from an electric machine and lightning by his famous kite experiment in 1752 An amateur also, Oliver Heaviside first pointed out that electromagnetic waves might be reflected by a conducting layer in the upper air, now called the Heaviside layer, which makes radio communication around the world possible, and amateurs first established world communication with short waves 300 metres or less in length In transport also, through the experiments of Wilbur and Orville Wright the conquest of the air has been due chiefly to the pioneer work of amateurs Every encouragement should be given therefore, to all such voluntary workers in scientific fields

THE following officers were elected at the annual general meeting of the Royal Meteorological Society, held on Jan 16 —*President* Sir Richard Gregory, *Vice Presidents* Mr R Arniston, Lieut Col E Gold, Mr I D Margary, and Mr R A Watson Watt, *Treasurer* Mr F Druce, *Secretaries* Dr C E P Brooks, Commander L G Garbett, and Dr A Crichton Mitchell, *Foreign Secretary* Mr R G K Lempfert

THE following officers were elected at the meeting of the Royal Microscopical Society on Jan 16 —*President* Mr J E Barnard *Vice Presidents* Dr R S Clay, Dr J A Murray, Dr A S Parkes, and Mr E A Robins, *Treasurer* Mr Cyril F Hill, *Secretaries* Prof R Ruggles Gates and Dr Clarence Tierney

PROF D'ARCY W THOMPSON, professor of natural history in the University of St Andrews, has been elected a corresponding member of the Société de Biologie, of Paris

PROF P W BRIDGMAN, Hollis professor of mathematics and natural philosophy at Harvard University, will deliver the Guthrie Lecture for 1929 of the Physical Society of London on April 19 next

MR FRANCIS P LE BUFFE, managing editor of *Thought*, objects to a comment made in an article on "Evolution and Fundamentalism," in NATURE of Dec 22 He did not in his article in *America* suggest "that science should be looked on askance" In a letter correcting this remark he adds, however, "I did most emphatically suggest that so called 'scientists' and romancing scientists should 'be looked on askance'"

MR THOS J OFFER, a member of the organising committee of the scientific, optical, and photographic section in the forthcoming British Industries Fair, informs us that readers of NATURE who may be interested can obtain an invitation ticket to the Fair on application to the Department of Overseas Trade, 35 Old Queen Street, S W 1 The scientific instrument section of the Fair has grown considerably in size and importance (see NATURE, Oct 20 1928, p 631), and we hope that all scientific workers who are at hand will take the opportunity of visiting it

ON Tuesday, Jan 29, at 5 15, Prof Julian S Huxley begins a course of six lectures at the Royal Institution on evolution and the problem of species, and on Thursday Jan 31, Sir William Bragg gives the first of three lectures on the early history of X rays The Friday evening discourse on Feb 1 will be delivered by Prof J L Myres on geometrical art in south eastern Europe and western Asia, and on Feb 8 by Mr C E R Sherrington on recent problems of rail transport

AT the monthly general meeting of the Zoological Society of London, held on Jan 16, it was stated that the total number of visitors to the Society's Gardens during the past year was 2,225,662, the receipts amounting to £71 656, an increase of more than £3000 as compared with the previous year, and an increase of nearly £10,000 when compared with the average for the previous five years The year 1928 was by far the best in the history of the Society The visitors to the Society's Aquarium during the year numbered 444,177, the receipts amounting to £17,393, showing a decrease of £900 as compared with the previous year

AT the autumn meeting of the Iron and Steel Institute at Bilbao, Prof Henry Louis formerly professor of mining and metallurgy at Armstrong College, Newcastle on Tyne, was unanimously nominated for election as the next president of the Institute, and he will take office at the annual meeting in London on May 2 Prof Louis being a prominent citizen of Newcastle upon Tyne, the members resident in that neighbourhood considered that it would be very appropriate to hold the autumn meeting of this year in that city, and the Lord Mayor and corporation of the city have sent a cordial invitation to the Council of the Institute to hold the meeting there The date of the meeting has been fixed for Sept 10–12

RECENT appointments to scientific and technical departments made by the Secretary of State for the Colonies include the following —Mr D P McGregor to be geologist in the Gold Coast, and Mr K R S Morris, assistant entomologist in the same Colony, Mr J D Shepherd to be irrigation officer in the Agricultural Department, Palestine, Mr M Vardy to be manager, Experimental Fruit Farm, Sierra Leone, Mr E Messervy to be veterinary officer in Tanganyika Territory Among the transfers and

promotions are the following —Mr H M Gardner, senior assistant conservator, to be conservator of forests, Kenya Colony, Mr L P Henderson, agricultural instructor, Federated Malay States, to be superintendent, Agricultural Department, Nigeria Mr G N Sale, assistant conservator of forests, Cyprus, to be director of forests, Mauritius, Mr D Stevenson, deputy conservator of forests, British Honduras, to be senior assistant conservator of forests, Northern Rhodesia

A SHORT catalogue (No 6) of books, mainly of botanical and zoological interest, has reached us from Mr J H Knowles, 92 Solon Road, S W 2

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —A full time lecturer in electrical engineering in the Leicester College of Technology—The Registrar, College of Technology, Leicester (Jan 31) A resident librarian at the Liverpool Medical Institution — The General Secretary, Medical Institution, Liverpool (Feb 4) A principal of the Kirkcaldy High and Technical School—The Education Offices, Kirkcaldy (Feb 9) A junior technical officer in the design section of an Admiralty Establishment at Portsmouth—The Secretary of the Admiralty (C E Branch), Whitehall, S W 1 (Feb 9) A research assistant in agricultural economics and a student assistant in agricultural economics in the Department of Agriculture of the University of Leeds —The Registrar, The University, Leeds (Feb 11) An assistant in pathological chemistry in the University of Cape Town—The Secretary, Office of the High Commissioner for the Union of South Africa, South Africa House, Trafalgar Square, W C 2 (Feb 26) A bacteriologist in the department of agriculture of the Irish Free State—The Secretary, Civil Service Commission, 33 St Stephen's Green, Dublin, C 2 (Mar 19) A senior lecturer in psychology in the Rhodes University College, Grahamstown — The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W C 2 (April 1) Civilian education officers in the Royal Air Force Educational Service—The Secretary, Air Ministry, Gwydyr House, Whitehall, S W 1 An assistant master, to teach physics and mathematics, at the Guildford Junior Technical School—The Clerk to the Governors, Technical Institute, Guildford A Government chemist for Fiji — The Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, Whitehall, S W 1 Short service officers in the Royal Air Force —The Secretary, Air Ministry, Kingsway, W C 2 Aircraft apprentices in the Royal Air Force—The Royal Air Force, Gwydyr House, Whitehall, S W 1 A junior assistant (male) under the Directorate of Radiological Research, Research Department, Woolwich—The Chief Superintendent, Research Department, Woolwich, S E 18 An assistant civilian experimental officer for a Governmental Experimental Establishment—The Secretary, R E Board, 14 Grosvenor Gardens, S W 1

Our Astronomical Column

NEW COMET SCHWASSMANN WACHMANN, 1929 *a* — Prof A Schwassmann and Dr A Wachmann discovered a very remarkable comet on Nov 15, 1927, at Bergedorf Observatory They have now found a second comet, the following details have been communicated in a telegram from the I A U Bureau, Copenhagen Time of observation Nov 17^d 22^h $21^{\cdot}9^m$ U T, R A 5^h 40^m 32^s, N Decl 20° 30′, daily motion -28^s, N 3′, magnitude 11 The comet is close to the ecliptic, and was doubtless discovered, like the other one, in the course of the photography of minor planets that is carried on at Bergedorf If the motion continues slow, there ought to be no difficulty in picking the comet up by Jan 25, the moon being then out of the way at the beginning of the night

RECENT SOLAR ACTIVITY — A large group of spots crossed the sun's disc between Jan 11 and 23 The spots were in stream formation with a large leader spot when seen on Jan 16, but when next observed on Jan 19, the group had altered considerably and the spots were breaking up No magnetic disturbance was registered at Greenwich about the time of central meridian passage of the group Besides this group there was another group, somewhat smaller, about 60° of longitude eastwards and on the other side of the equator Particulars of position and area of the two groups are as follows

No	Date on Disc	Central Meridian Passage	Latitude	Max Area
1	Jan 11–23	Jan 17 4	7° N	1/800 of hemisphere
2	Jan 16–28	Jan 21 8	11° S	1/1200 of hemisphere

Sunspot activity during 1928 was considerable Notes on about a dozen large groups, each seen for at least two or three days as a naked eye object, were given in NATURE at their times of occurrence According to a report in *Jour Brit Astron Assoc* for December 1928, the mean daily area of spots for the year was about 1250 millionths of the sun's hemisphere, as compared with 1058 for 1927 and 1262 for 1926 The maximum of the present cycle is therefore not sharply defined as was that in 1917 of the preceding cycle The curve for mean areas gives for the present cycle a double peak in 1926 and 1928, whilst the curve plotted from the average daily number of spots, irrespective of size, gives a rather indefinite maximum centring about 1927, although the top of the peak seems to have been reached in 1928 It may be anticipated that the sun's activity will show signs of a decline during 1929

MARS —Few results for the present apparition of Mars have yet been published, Dr W H Steavenson has noted the reappearance of a broad, oblique, dark marking sloping upwards to the right, south of Pandoræ Fretum *L'Astronomie* for December contains some beautiful drawings made at the 1926 opposition by M E M Antoniadi with the 0 83 m refractor at Meudon There is some trace of the above oblique band shown on them He notes that in the regions enjoying summer there is a tendency for yellowish veils, which he ascribes to clouds of fine sand raised from the desert regions, to dim the surface markings The darker markings showed a great variety of tints, red, green, blue, violet, and brown all appear in his descriptions Solis Lacus was green in September 1926, greenish grey in November, and brown in December This marking appears to have expanded in the north south direction as compared with former years

Research Items.

EUROPEAN GYPSIES IN EGYPT —In the *Journal of the Gypsy Lore Society*, vol 7, ser 3, pt 2, Dr John Sampson, citing a paper published by Capt Newbold which appeared in the *Journal of the Royal Asiatic Society* in 1856, analyses a vocabulary there given of the Ghagars, one of the three gypsy tribes which the author met in Egypt The Ghagars themselves spoke of having brethren in Hungary, but this reference had been overlooked by later writers, who had not doubted that they belonged to the eastern Romani groups, which includes the Helebis of Egypt, the Nawar of Palestine, the Kurbat of Syria and Persia, and the Karaci of Asia Minor and Transcaucasia A re examination of the vocabulary, however, shows close affinities with the dialects of western Romani especially of the Balkan and eastern European gypsies, though coupled with borrowings from the eastern Romani with whom they obviously have been in contact for a considerable time It would appear from their vocabularial and phonetic peculiarities that the Ghagars must have originated in the region of Mol davia, of which Bukowina and Bessarabia are the modern linguistic representatives In 1322, Symon Simeonis, in his "Itinerarium," recorded the existence of a people in Alexandria and Cairo who from their characteristics were clearly gypsies who had come as prisoners of war from the Danube, and though these are probably too early in date for it to be likely that they are Ghagars, it is possible that the latter are transported prisoners of the later wars between Turk, Hungarian, and Pole in the seventeenth century

SIGNIFICANCE OF THE MOULTING OF FEATHERS —In a careful analysis of the succession of moults in the loggerhead shrike (*Lanius ludovicianus*) and its sub species, Alden H Miller finds evidence of a correlation with climatic differences (*Univ California Pub Zool*, vol 30, No 13, 1928) The adaptive significance in the moult lies in the need for keeping the minimum level of plumage (or flight) efficiency as high as possible In the wings and tail this end is supposedly accom plished by the alternating moults of different series of feathers, and in the remiges and rectrices, particularly, by the replacement of the least important feathers first, in order that more of the series may be new when the most important feathers are lacking But this does not meet all the case The facts that the long central pair of rectrices and the largest of the inner secondaries drop first, and that the alula and outer primaries are lacking at the same time, are not easily explained on the same basis The author reaches the conclusion, therefore, that although all phases of moult order must be adjusted at least to the extent that the birds are able to survive, there is still to be seen in the moult behaviour of certain feathers, in addition to adaptation, a definite reflection of either embryonic or phylogenetic homologies, or perhaps both The extent to which all these factors enter in various degree into the moults of different subspecies can only be elucidated by further investigation of the phenomena in this and other species

AN AMERICAN GENUS OF LIZARDS —Knowledge regarding the genus *Ctenosaura*, a series of large tree and rock lizards, some of which may exceed three feet in length, has been unsatisfactory, and the extent of the unsatisfactoriness may be gathered from John Wendell Bailey's "Revision," in which the 27 reputed species have dwindled under critical examination by more than 50 per cent (*Proc U S Nat Mus*, vol 73, art 12, 1928) The thirteen recognised species are confined to Mexico and Central America, and the most widely distributed, and at the same time the most primitive species, happens to be that first described in 1802 The new analysis shows that it is impossible to distinguish *Ctenosaura* from allied genera by any structure of skeleton, and reliance has been placed upon the usual external characters Indefiniteness also shrouds the geological history of the genus, but it would appear to be closely related to, and to have been derived from, a common iguanid stock, from the head quarters of which in central western Mexico it spread in even waves north and south At the present day, the transition in morphological characters from this centre of distribution is a gradual one, without any break in the series These lizards are active and powerful, and are able to inflict nasty wounds by the use of their small sharp teeth, and by the lashing of their spiny tails

SOME INDIAN FISHES —Dr Sunder Lal Hora and Mr D D Mukerji give a detailed survey of the genus *Esomus* ("Notes on Fishes in the Indian Museum, XVI On Fishes of the Genus *Esomus* Swainson," *Records of the Indian Museum*, vol 30, pt 1, 1928) These are small cyprinid fishes with elongated and strongly laterally compressed body, and amongst other characters, with two pairs of barbels at the corners of the mouth, one pair short and the other pair very long, sometimes extending as far back as the base of the anal fin These barbels give the fishes a peculiar and distinctive appearance The genus occurs in British India, Ceylon, Nicobars, Malay Peninsula, Malay Archipelago, and French Indo China The authors have reduced the Indian species, of which there were a number, to five *Esomus danicus* is the commonest, inhabiting ponds and ditches, *E altus* is a Burmese species, a fine series of which was purchased by Dr Annandale from the Mandalay market, probably the commonest species in Ceylon is *E thermoicus*, originally described from the hot springs in Kanniya, but apparently no longer to be found in them In the same volume of the *Records* the senior author describes a new species of *Brachydanio* and gives a few notes on other Burmese fishes ("Notes on Fishes in the Indian Museum XV") In part 2 Mr J R Norman continues his report on the Indian Heterostomata ("The Flatfishes (Heterostomata) of India, with a List of the Specimens in the Indian Museum," part 2), the first part having appeared in the previous volume The families Soleidæ and Cynoglossidæ are now dealt with There are eight genera of the Soleidæ in Indian waters and three of the Cynoglossidæ, by far the larger number of these last belonging to *Cynoglossus* Plates representing four of the Soleidæ show the striking form of *Brachirus macrolepis* and three species of *Zebrias* with their wonderful transverse markings from which the genus is named

BRYOZOA OF THE AUSTRALIAN ANTARCTIC EXPEDI TION —Mr Arthur A Livingstone, assistant zoologist in the Australian Museum, Sydney, gives a detailed supplementary report on the Bryozoa of the Australian Antarctic Expedition, 1911-14 (*Scientific Reports*, Series C, Zoology and Botany, vol 8, Part 4, 1928) The first report was made by Miss L R Thornely and published in New South Wales by the Austral asian Antarctic Publication Committee (Series C, 6 6, Polyzoa, 1924) It was found, however, that the material sent to Miss Thornely was not complete, as a large portion of it had been overlooked Hence the present volume, in which the original classification and many of the identifications have been considerably

altered Two of Miss Thornely's new species have been placed in new genera *Cellaria membranacea* in the new genus *Mawsonia*, *Aspidostoma obliquum* in the new genus *Pseudocellaria* *Membranipora elongata* Thornely is shown to be *Ogivalana lata* (Kluge), and this forms only the second record from the Antarctic, Kluge's original description being here supplemented by further notes The paper is illustrated by beautiful photomicrographs by Mr G C Clutton and by clear diagrammatic text figures by the author

The Plant Wall in the Light of Digestion Experiments —Max Rubner gives, in *Die Naturwissenschaften* for Nov 30, 1928, a general account of the physiological significance of the main components (pentosans, celluloses, and lignins) of the plant wall from the point of view of digestion experiments that were carried out in Germany during the War and the immediate post War period From this account, several conclusions of general interest emerge In experiments upon animals and upon man, there was often a remarkable difference in the degree of digestion of cellulose material from the same food stuff in different experiments upon the same subjects Some of this difference may be due to difference in the bacterial flora of the intestinal tract, but the differences are so marked that Rubner concludes they point to the existence of many different forms of cellulose As the same differences appeared when the purified celluloses from these food products are fed to animals, it does not seem possible to attribute them to the different extent to which the plant membrane is impregnated with fatty substances or lignins Rubner discusses the wide variations in the methods used by different investigators to separate the lignin from the plant membrane with the result that very different substances are probably included under this name In any case it appears from the analysis of pentosans, cellulose, and lignin in a vegetable food material, before and after its passage through the mammalian alimentary canal, that in many cases a certain amount of the lignin fraction must undergo digestion Whilst it is probably true that heavy lignification is associated with relative indigestibility, it would not seem safe to assume that the only constituent of a lignified plant wall to undergo digestion is any inner lining of pentosan character that may be present

Nitrogen Cycle in the Soil —Carsten Olsen (*Comptes rendus du Laboratoire Carlsberg*), working on the significance of the hydrogen ion concentration for the cycle of nitrogen transformation in the soil, has determined that ammonification can proceed in soils with pH values between 3 7 and 9 0, the process being most active when this value lies between 7 0 and 8 5 Nitrification can proceed in soils with pH between 3 7 to 8 8, the optimum being at pH 8 3 in soils rich in ammonia Under natural conditions, in soils with pH between 4 0 and 8 0, the rapidity of nitrification is determined by the rate of ammonification, as the latter process limits the former In strongly acid soil which is rendered alkaline by the addition of calcium carbonate, there takes place very rapidly a powerful nitrification unless it is necessary to add inoculating soil from an alkaline reacting soil Provided the nitrifying bacteria working in the acid soil are special kinds which cannot work in alkaline soil, the bacteria working in the alkaline soil must either be found in small quantities in the originally acid soil or be introduced in dust The latter suggestions seem quite feasible, as the nitrifying organisms are not killed when soil containing them is dried out at ordinary room temperature, and transportation as dust from one locality to another is therefore possible

Classification of Oceans and Seas —Oceanographers have made several attempts to find a satisfactory classification of oceans and seas, but no general agreement has yet been reached M C Vallaux has an article on this subject in *La Géographie* for September–October 1928 (vol 50, Nos 3 4) He develops the idea that most classifications take too much account of the arbitrary divisions of the waters that are the outcome of practical use, and thus in consequence the important physical considerations tend to be lost to sight The classification M Vallaux suggests is a simple one He recognises four oceans, Southern, Pacific, Indian and Atlantic The Southern Ocean has climatic limits, lat 35° S and the Antarctic Circle The others have mainly topographical boundaries, except that the Atlantic Ocean ends at the Arctic Circle in the north east Seas are divided into four groups Icy seas (*mers glacées*) are the Arctic sea and the marginal Antarctic seas Garland seas (*mers guirlandes insulaires*) include the Bering, Okhotsk, Japan, China, and Andaman Seas Mediterranean seas, which generally have deep basins, mark lines of instability in the earth's crust Lastly, shallow seas include the Persian Gulf, the Baltic, Hudson Bay the Gulf of St Lawrence, the North Sea, the English Channel, and the Irish Sea According to M Vallaux, calculations gives the areas of the oceans in millions of square kilometres as follows Southern, 85 5, Pacific, 126 9, Indian, 42 4, and Atlantic, 58 2 The areas of seas are also given in the paper

New Pendulum Apparatus for Gravity Work —Interesting and important advances in pendulum apparatus for the determination of gravity are embodied in the new Cambridge apparatus described by Sir Gerald Lenox Conyngham, its inventor, at the Royal Geographical Society meeting of Jan 14 The instrument is made by the Cambridge Instrument Company Ltd, and many of its parts were specially designed by the late Sir Horace Darwin The object aimed at was the determination of the time of swing to 2×10^{-7} second when the time is reduced to its estimated value under ideal conditions, that is, *in vacuo*, at standard temperature, with an infinitesimal arc of vibration, and in a perfectly steady and rigid stand In the Cambridge apparatus, an airtight chamber is used and the pressure is reduced to between 60 mm and 80 mm of mercury, the value being easily measured and controlled, while the pressure constant is well determined The rods which start or lift and lower the pendulums pass through stuffing boxes which possess an oil seal The pendulums are made of nickel steel, of the same composition as invar, and the temperature correction is small and well determined Provision is made for measuring the arc of swing, in order to allow for it In order to prevent the motion of the pendulum from setting its case and stand in vibration, two pendulums, carefully adjusted to the same period, and swinging in opposite phase in the same plane, are used In order to eliminate any influence of movements of the pillar on which the apparatus may be placed, use is made of the device of Vening Meinesz, in which a third stationary pendulum of similar construction, and able to swing in the same plane, is placed between the two pendulums The optical arrangements for observing the motion of the pendulums are ingenious, and are described in detail in the account which is to appear in the *Geographical Journal*

A New Method for Investigating γ Rays —A method for finding the direction of hard γ rays which does not require the delineation of a pencil by screens has been devised by W Bothe and W Kolhörster

It employs instead the fact that secondary electrons which have been set free by waves of very high frequency move off from their parent atoms approximately in the direction of the radiation The trajectory of the electrons can be found by setting a pair of Geiger electron counters in various positions until they show a maximum number of coincident discharges due to the individual electrons affecting each in turn, when their common axis must be in the line of the incident γ rays So far, the authors have only published a short preliminary account of their method (*Die Naturwissenschaften*, Dec 7), but it has an obvious application to the problem of the origin of the cosmic rays, which can be particularly well studied by means of it because of their extremely short wave lengths They mention that when relatively soft rays are excluded by a filter of 10 cm of lead, the number of coincident discharges of the counters which cannot be ascribed to the presence of radioactive substances is increased threefold by rotation of the detecting system from the horizontal to the vertical

ELECTRIC HEATING AND VENTILATION —Most of the problems connected with the electrical heating of rooms have now been satisfactorily solved A problem which deserves more careful consideration, however, is that of the ventilation of electrically heated rooms, especially when they have no chimney or when as is usually the case, the chimney has been bricked up In the case of large shops where there are crowds of customers, the difficulties to be overcome are many Messrs Bourne and Hollingsworth, Ltd, of Oxford Street, London, are to be congratulated on the arrangements they have made for heating, ventilating, and cooling their departments A full account of the arrangements made is given in the *Electrical Review* for Jan 11 Provision has been made with the Marylebone Corporation for a supply of 3500 kilowatts The installation is probably the largest of its kind in the world The floor space is 160 000 square feet and the volume of the air is two million cubic feet The air is maintained at an average temperature of 62° F throughout all the rooms and floors served It is also renewed seven times every hour The operating principle employed is that of blowing hot or cold air by means of fans into the various departments The temperature and volume of the air admitted is regulated from a central control room From this room all the motors, fans, heaters, and dampers are controlled by switches The temperatures registered at fifty appropriate places are indicated in the control room and four records can be taken simultaneously It is claimed that the temperature of the entire building can be maintained within one degree Fahrenheit no matter how the outside temperature and the number of persons in the building vary This scheme was adopted as the estimates showed that it was cheaper than any of the others proposed

ROWLAND'S WAVE LENGTH AND TABLES —For just over thirty years, Rowland's "Preliminary Table of Solar Spectrum Wave lengths" has provided the world with a valuable standard of reference But since it was published our standard of accuracy has risen, a new system of laboratory standards has been developed and adopted, and the time has come for the "Revision of Rowland's Preliminary Table of Solar Spectrum Wave length," with an extension to the present limit of the infra red (10,218 I A) For this most valuable work we have once more to thank the United States, and in particular Dr C E St John and his colleagues In their identifications of the lines they have many physical considerations unknown in Rowland's day to help them towards their decisions, in particular, the knowledge of the excitation potential required to raise the atom from its lowest energy state to the state in which it can absorb a given line is now very frequently known and also the groups of lines which should occur together Only one criticism need be made of the necessary economy in printing and choice of data to be given In Table VI the designations for excitation potentials corresponding to the higher terms involved in any transition might have been added This would have enabled a student to give the complete multiplet designation of any line in which he was interested without reference to the source used in preparing the main table The list of references to these sources is not the least valuable part of the volume We may note that 57 elements have been identified in the sun, and 32 of these as ionised elements also No evidence of double ionisation has been found Of the 35 elements not identified definitely, 18 are doubtfully possible of detection Only 175 lines of intensity 2 or higher remain unidentified The work is a fine performance, and it is in its favour that it must leave the reader with an even higher opinion of the value and accuracy of Rowland's original table than he had before

CONTACT CATALYSIS —The National Research Council of the U S A has recently published the Sixth Report of the Committee on Contact Catalysis, by R E Burk, in collaboration with other members of the Committee (*Reprint and Circular Series of the National Research Council* No 83 (Washington, D C National Academy of Sciences)) The report first appeared in the *Journal of Physical Chemistry*, vol 22, 1928, p 1601 In addition to covering new developments, the present report summarises the five previous reports, and an attempt has been made to include relevant work in other fields

ALKYL ORTHOSILICATES —The *Journal of the American Chemical Society* for November contains an account by A W Dearing and E E Reid of an improved method for the preparation of ethyl orthosilicate and the synthesis of a number of new orthosilicate esters The ethyl orthosilicate has been converted into silica gel by the addition of the calculated amount of water together with 1 5 times its volume of alcohol This gel, which was free from strong electrolytes, showed the same absorption as ordinary silica gel obtained from sodium silicate, but had a greater catalytic activity A non aqueous gel was prepared by refluxing the ester with acetic acid, excess of which was removed by dry benzene

THE DISCOVERY OF ETHER —The discovery of diethyl ether is usually attributed to Valerius Cordus (1515–1544) In an article in the *Journal für praktische Chemie* (Bd 120, 74 88, 1928) Dr Ernst Darmstaedter critically considers Cordus's account of the preparation of *oleum vitrioli dulce* and reaches some very interesting conclusions He shows that Cordus first mixed fuming sulphuric acid with alcohol and allowed the mixture to stand for one or two months At the end of this time the liquid was placed in a distillation apparatus and gently heated "until the alcohol originally added" was removed The temperature was then raised and the distillate collected This consisted of two layers, namely, water and the 'sweet oil of vitriol' assumed by later writers to have been ether Darmstaedter points out that the properties of the oil as described by Cordus do not agree with those of ether, and demonstrates conclusively that the *oleum vitrioli dulce* must have been diethyl sulphate He believes that Cordus probably never once suspected the existence of the very volatile ether Cordus mentions that only a small yield is obtained, a statement in agreement with modern observations (Villiers, 1903, says that 200 grams of ethyl alcohol yield only 30 grams of diethyl sulphate)

Annual Prize Awards of the Paris Academy of Sciences

AT the annual public meeting of the Paris Academy of Sciences on Dec 17, the prizes and grants awarded in 1928 were announced as follows

Mathematics—The Poncelet prize to Gaston Julia for the whole of his mathematical work, the Francœur prize to Szolem Mandelbrojt for his work in mathematical analysis

Mechanics—The Montyon prize to Filippo Burzio for his work in ballistics, the Henri de Parville prize to F C Haus for his researches in aeronautics

Astronomy—The Lalande prize to Bernard Lyot for his work on the polarisation of the planets, the Valz prize to Georges van Biesbroeck for the whole of his astronomical work, the Janssen medal to William Wright for the whole of his work

Geography—The Delalande Guérineau prize to Paul Serre for his scientific collections during the last thirty years, the Gay prize to Henri Gaussen for his contributions to the study of the flora, climate, and geology of the eastern Pyrenees, the Tchihatchef foundation to Eugène Poilane for his botanical and entomological collections in Indo China, the Binoux prize (in equal parts) between Carlos Ibañez de Ibero for his work in connexion with the proposed tunnel under the straits of Gibraltar, and the late Paul Soulier for his work on the origin and evolution of the earth's relief

Navigation—The prize of six thousand francs to Dieudonné Costes and Joseph Marie le Brix for their remarkable flight, the Plumey prize to Albert Thuloup for his memoir on the fatigue of thin pipes

Physics—The L Lacaze prize to Charles Mauguin for the whole of his work in crystallography, the Kastner Boursault prize to Pierre Auger for his work on the structure of the atom, the Hébert prize to Jean Granier for his book on electrical measurements, the Hughes prize to Jean Thibaud for his work on the X rays, the Danton foundation to Pierre Bricout for enabling him to continue his researches on the measurement of radiation the Clément Félix foundation to Paul Woog for the continuation of his work on oiliness

Chemistry—The Montyon prize (unhealthy trades) to Mme Mélanie Rosenblatt, for her work on the study of poison gas and of the means of protection against it, the Jecker prize to Victor Auger for the whole of his work, the L La Caze prize to Paul Pascal for his work in pure and applied chemistry, the Cahours foundation to Mme N Demassieux for her physico chemical work, the Houzeau prize to Albert Portevin for his work in metallurgy

Mineralogy and Geology—The Victor Raulin prize to Jean Orcel for his work on the chlorites, the James Hall prize to Jean Piveteau for his memoir on the Permian of southern Madagascar and its quadruped vertebrate fauna

Botany—The Desmazières prize to Léonidas Grigoraki for his work on parasitic fungi, the Montagne prize to Roger Werner for his memoir on biological and experimental researches on the ascomycetes of lichens, the de Coincy prize to Mlle Gabrielle Bonne for her memoir on the pedicel and flower of the Rosaceæ An honorable mention to (the late) Eugène Perrier de la Bathie

Anatomy and Zoology—The Cuvier prize to Louis Boutan for the whole of his zoological work, the Savigny prize to J L Dantan for his study of the plankton flora of the bay of Algiers and other biological work, the Jean Thore prize to Étienne Hubault for his work entitled "Contribution à l'étude des Invertébrés torrenticoles"

Medicine and Surgery—Montyon prizes to Maurice Chiray and Ion Pavel (2500 francs) for their work on the gall bladder, Edmond Papin (2500 francs) for his book on the surgery of the kidney, Gustave Worms (2500 francs) for his memoir on the pathological anatomy of the thymus Honourable mentions (1500 francs) to Albert Berthelot, to Gaston Ramon, and to Mlle Germaine Amoureux for their bio chemical researches on the toxins and their derivatives, to Charles Foix and Julien Marie for their work entitled "La sclérose cérébrale centro lobaire à tendance symétrique, ses rapports avec l'encéphalite périaxale diffuse", to Édouard Schoull and Louis Weiller for their work on the use of creosote in the treatment of pneumococcus Citations to Pierre Dombray, Charles Lombard, Jean Nicolaïdi, and to A W Turner and J Daveene The Barbier prize to Joseph Belot and François Lepennetier for their memoir on the radiographic anatomy of the normal skeleton, the Bréant prize between Georges Blanc (3000 francs) for his experimental researches on herpes, and Édouard Rist (2000 francs) for his work on tuberculosis, the Godard prize to Paul Bordas for his studies on the kidney and surrounding tissues, the Bellion prize to Noël Fiessinger and Henry Walter for their work on the functional exploration of the liver and hepatic insufficiency, the Larrey prize to Antony Rodiet and Fribourg Blanc for their work on mental troubles and the War of 1914-1918

Physiology—The Montyon prize to Maurice Rose for his work on phototropism and on plankton, the La Caze prize to Louis Lapicque for the whole of his work in physiology, the Pourat prize to Robert Courrier for his work on the determinism of secondary sexual characters, the Martin Damourette prize to Eugène Jamot for his researches on the treatment of sleeping sickness, the Philipeaux prize to François Granet for his work on the pseudobranch of fish

Statistics—The Montyon prize to Georges Darmois for his memoir on mathematical statistics

History and Philosophy of Science—The Binoux prize to André Metz for his work entitled "Une nouvelle philosophie des sciences Le causalisme de M Émile Meyerson", the Henri de Parville prize (2500 francs) to Alfred Chapuis and Édouard Gélis for their book "Monde des automates, étude historique et technique", also prizes (1000 francs each) for the books 'Science et travail Grande encyclopédie illustrée des nouvelles inventions" (editor J L Breton) and "Microbiologia aquaria e tecnica," by Gino de Rossi

Medals—Berthelot medals to Mme Mélanie Rosenblatt, Victor Auger, and Albert Portevin

General Prizes—The prize founded by the State (Grand Prize of the mathematical sciences) to Georges Giraud for his work on partial differential equations, the Bordin prize to Louis Fage for his zoological work, the Lallemand prize to Mlle Fernande Coupin for her work on anthropoid apes, the Vaillant prize to Maurice Frechet for his work on abstract ensembles, the Estrade Delcros prize to Pierre Jolibois for his chemical work, the Houllevigue prize between Paul Danguy for his researches on the flora of Madagascar and of Siberia, and Mme Yvonne Gubler Wahl for her work on the geological survey of France, the Saintour prize to Émile Terroine for his researches on the physiology of nutrition, the Lonchampt prize to Maurice Javillier for the continuation of his work on the mineral composition of plants, the Wilde prize to Albert Pérard for his work in metrology and physical optics, the Caméré prize to Louis Biette for his book entitled "Les chemins de fer urbains parisiens"; the Roux prize to François Divisia for his memoir on rational economics, the Thorlet prize to Adolphe

Richard, the Albert 1st of Monaco prize to A Cotton for the continuation of his researches on powerful magnetic fields

Special Foundations—The Lannelongue foundation between Mmes Cusco and Rück, the Helbronner Fould prize to Mme Marcel Bertrand for assisting the publication of the collected researches of the late M Bertrand

Prizes of the Grandes Écoles—The Laplace prize to Pierre Robert, the L E Rivot prize between Pierre Robert, Alphonse Grange, Roger Dodu, and Marcel Davin

Foundations for Scientific Research—The Trémont foundation to André Charrueau for his researches on the equilibria of fluids, the Gegner foundation to Maurice Vèzes for his treatise on physical chemistry, the Jérome Ponti foundation to Pierre Cappe de Baillon for his researches on the teratology of insects, the Hirn foundation to Maurice Gevrey for his work on partial differential equations, the Henri Becquerel foundation to Paul Lévy for his works on functional analysis

THE LOUTREUIL FOUNDATION

The Academy received 31 requests for grants from this foundation, 25 of which were acceded to as follows

National Museum of Natural History, 11,000 francs for the establishment of a catalogue of the books in the laboratory libraries 12,000 francs to the École Polytechnique for the use of the library, 2000 francs to M Nicolas, director of the National Veterinary School of Alfort, for his biochemical researches on thioureas and its derivatives, 4000 francs to M Maignon for continuing his researches, especially on the influence of the seasons and of the genital glands on basal metabolism and the specific dynamic action of foods in the dog, 4000 francs to the National Veterinary School of Lyons for the completion of sets of foreign periodicals in the library, 4000 francs to the National Veterinary School of Toulouse for additions to its library, 4000 francs to the National Agronomic Institute for the completion of sets of periodicals in its library interrupted by the War, 3000 francs to Paul Nottin for his researches on the saccharification of starch

Conservatoire national des Arts et Métiers—5000 francs to Léon Guillet for the purchase of material for researches on the action of repeated stresses on metals and for the development of installations for thermal treatment, 4000 francs to the library for the purchase of books

Grants other than to Institutions—5000 francs to René Jeannel for the publication of parts 57 to 59 of the zoological studies undertaken on material collected in the course of the expedition made by him (with M Alluaud) in Central Africa, 5000 francs to Louis Bazy for his researches on the curative and preventative properties of the bacillus of paratuberculous enteritis of cattle and of its extracts, 5000 francs to Mme Delage as the last contribution to the publication of the last volume of the biological annual, 1000 francs to Édouard Doublet for the publication of a historical work on Gustave Lambert, 2000 francs to Henri Douvillé for the research in the field of fossils permitting the completion of the study of the Rudist limestones of the Pyrenees, 5000 francs to the "Faune des Colonies françaises", 2000 francs to Gaston Fayet to ensure the regular publication of the *Bulletin* of the Nice Observatory 5000 francs for the publication of material collected by the cruises of the *Travailleur* and the *Talisman*, 6000 francs to Henri Humbert to contribute to his studies of the flora of the high mountains of Madagascar and its comparison with that of tropical Africa, 3000 francs to the Institut d'Optique for the purchase of books to complete its library 8000 francs to Jean Mascart to contribute towards the cost of printing observations of work carried out or centralised at Lyons, 5000 francs to the Paris Observatory for completing the publication of Lalande's catalogue, 8000 francs to the Zo Se Observatory to assist in the publication of observations made at this Observatory, 4000 francs to Jean Piveteau to undertake geological and palæontological researches in southern Tunis, 8000 francs to J Risbec for the purchase of apparatus to enable him to carry on his biological researches in New Caledonia

The Mme Victor Noury foundation between Fernand Blondel (4000 francs) for his work on the geology of Indo China, René Fortrat (3000 francs) for his work on spectroscopy, and Lucien Klotz (3000 francs) for his work in connexion with the rights of authors and scientific men and the protection of scientific property the Bouchard foundation to Constantin Toumanoff for the continuation of his researches on the normal and pathological (microbial diseases) physiology of insects, the Ray Vaucouloux foundation to Claudius Regaud for the whole of his work on the action of radium and of the X rays on normal and on pathological tissues, with special reference to the use of the radiations in the treatment of various cancerous growths

Annual Meeting of the Mathematical Association

"WHERE you find a low standard of education, there you find with it dark superstition and enslavement to formulæ in every aspect of life" No reader of NATURE is likely to quarrel with this statement (liberally misquoted from memory) with which Mr N J Chignell began his paper on "The Use and Abuse of Formulæ" at the annual meeting of the Mathematical Association on Jan 7 and 8 Happiest among his examples of the general formulæ that are being questioned by a world awaking to thought, before he came to those which belong distinctively to mathematics or science, was this "That a cloth cap must always be taken off in the presence of a top hat" Not many years ago, the ensuing discussion would certainly have brought to light some of our dear old friends with their final argument that "memorising formulæ gets boys through who are too stupid to pass in any other way" These are not extinct, but "the sun ariseth and they get them away together, and lay them down in their dens" Even the examiner, formerly the arch enemy, looks now for understanding rather than memory, so Prof Neville told us there is much that the examiner can do to help, by forbidding the use of unproved formulæ or by setting a question to which no 'crammable' formulæ apply

One of the quaintest of our modern superstitions is that the common methods of voting give us the representatives we want A singularly interesting paper by Prof J E A Steggall, illustrated by numerous examples from his own experience at Dundee, showed how remarkably effective they can be in giving us just those representatives whom the majority decidedly prefer to do without When two prizes for valour were to be awarded after the battle of Salamis, it is recorded that the commander of the contingent from every Greek state modestly recommended himself for the first prize and Themistocles for the second the system of counting first places only would have left the greatest soldier of his time at the foot of the poll Nearer home than that, it is no uncommon thing for *A* to be elected out of three candidates on

'first choice' votes alone, when actually a majority prefers B to A, and at the same time C is also preferred to A by a majority of the voters The impact of mathematical thought upon human affairs lags far behind the work of chemistry, electricity and psychology in making a world for man to live in this matter of elections of various kinds is conspicuously one in which the mathematician should feel his responsibility for making to the national thought that contribution for which his gifts and training fit him

Proportional representation, a plan lying outside the limits which time set to Prof Steggall's discussion, deserves from mathematicians (and others) far more notice than it has yet received, but this is distinctively a method of electing two or more it has nothing to tell us about the best way to pick out from a number of candidates the one who is preferred to the others individually by the largest majorities of the voters If twenty such candidates compete for one place, we should regard the contest as 190 duels between one candidate and another it is surprisingly easy, both for voter and for counter, so to arrange the election that the algebraic sum of every candidate's majorities in his 19 contests emerges directly from a single ballot

It is safe to forecast that for some centuries to come "Modern Mathematical Problems in Aerodynamics" will be a fruitful meeting ground for science and mathematics Prof H Levy's researches into the vortex motion set up in the air by the passage through it of an aeroplane's wing deserves something better than the comments of one ignorant of aerodynamics therefore let it pass unsung, but not unhonoured

"Should a candidate for School Certificate be allowed to take, in place of the Mathematics and Science Group, a Group containing Drawing and Music and possibly other subjects?" This was the principal subject for general discussion—a somewhat one sided discussion, because, though on details there was as much divergence of opinion as one would expect, there was but little opposition to the general principle involved that children well gifted and well taught in subjects of three different kinds should not be classified as educational failures because of weakness in a fourth Music, drawing and handicraft constitute a group at present generally inferior for certificate winning purposes to the other three, which are English subjects, languages, and the science mathematics group

This arrangement finds few defenders some of its opponents are for republican equality between all groups, others for supremacy of one only the English group A powerful advocate of this supremacy was Mr F H Knight, who boldly claimed for English subjects the place of honour as most of all a means of access to 'the things of the spirit,' without which other learning will not save the world Mr Knight also stressed the educational value of handicraft, not only as being for many children the only form in which solid geometry can be digested, but also for its influence on the development of mind on a wider scale than the mere book learner can ever appreciate

Science and mathematics are strong enough to stand on their own merits without needing to entrench their position by decrying the value of other subjects Generosity, justice, and common sense would alike have been outraged if the Mathematical Association had denied that to the artist his subject is of no less value than is ours to us Best of all, Demetrius the silver smith was conspicuous by his absence, "which made silver shrines for Diana," and whose trump card against a rival to his goddess was that "by this craft we have our wealth" W HOPE JONES

The Circulation of Seismological Information by Wireless Telegraphy

IN a recent issue of NATURE (Dec 22, p 968) a short account was given of the existing arrangements for broadcasting early information concerning important earthquakes, and it was announced that the co operation of American seismological stations would commence this month

The large earthquake which occurred on Jan 13 afforded an interesting test of the scheme, and it is satisfactory to record that data from all stations issuing broadcast seismological messages were picked up by the Air Ministry and communicated to Kew Observatory An early knowledge of the position of the epicentre and of the time of origin was thus obtained The following table summarises the information received at Kew

Station	Arrival of P, G M T	Interval (S − P)	Distance of Epicentre Δ	Azimuth of Epicentre (from N through E)	Time of origin deduced from (S − P) using B A tables
	h m s	m s	Km		h m s
Kew	0 14 49	9 34	8290	19	0 3 4
Helwan	0 15 41	10 9	8970		0 3 17
Bombay	0 14 12	9 0	7600		0 3 5
Stonyhurst[1]	0 14 39	9 21	7850		0 3 8
Georgetown	0 15 14	9 51	8620	330 ±5	0 3 9
Honolulu	0 11 32	8 50	5150	330 ±5	0 2 50
Strasbourg	0 14 34	9 39	8380		0 3 3

[1] The Stonyhurst figures were not broadcast but were received by post

The agreement between the figures in the last column is satisfactory, and for a preliminary value of the time of origin we may accept 0 h 3 m 6 s G M T

The accompanying diagram (Fig 1) is taken from

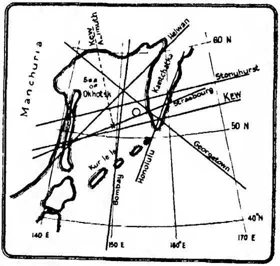

FIG 1

the globe on which the epicentral distances were marked off, the arcs in the neighbourhood of the epicentre are shown From the intersections the epicentre is estimated to have been approximately at the point which is marked with a circle, that is, 53° N, 153° E, in the Sea of Okhotsk near the western coast of Kamtchatka The initial impulse registered by the Kew seismographs (3 components) was sufficiently large to give a trustworthy estimate of the

bearing, which, together with the epicentral distance, gives 50° N, 150° E, for the co ordinates of the epicentre This determination is marked by a cross on the diagram The agreement with the result obtained by using data for the seven stations is as good as could be wished

The earthquake occurred in a region where such occurrences are frequent There were considerable earthquakes there on Feb 16 and Dec 28, 1927

University and Educational Intelligence

BIRMINGHAM —Mr R G MacGregor has been appointed lecturer in physiology

The University Appointments Board has issued its fourth annual report The report shows a marked increase in the number of new graduates registered, and in the number for whom employment has been found The demand for men and women with a university training appears to be definitely on the increase, particularly in commerce and industry It is noted that of a total of 45 vacancies notified for civil engineers, 44 were for posts abroad A significant fact is that, of the 64 registered graduates who are unemployed, 50 are seeking appointments in the teaching profession

CAMBRIDGE —The official letter conveying the offer of the International Education Board of £700,000 on condition that within a few years the University finds a further £229,000, in addition to the £250,000 already secured for the new Library, has now been received and published It deals most generously and helpfully with many minor points in connexion with the University, but there is a stipulation that no legacies shall be contributed towards the supplementary sum to be provided by the University, a stipulation not without interest to the University at the moment

Three further benefactions are announced A very valuable collection of medical, engineering, electrical, and optical apparatus bequeathed to the University by the late Sir David Goldsmid Stern Salomons Gonville and Caius College, subject to the life interest of his widow, has now been offered by Lady Salomons to the University The late Dr J W L Glaisher, Trinity College, has bequeathed his mathematical books to the University Library and his collection of china and pottery and other works of art to the Fitzwilliam Museum, with a sum of £10,000 to be applied in making provision for the care, preservation, and exhibition of the collection Messrs Bernard, Reginald, and Kenneth Pretty have offered to the University, at the wish of the late Miss Gwynaeth Pretty, Girton College, her residuary estate of the approximate value of £5000 for the furtherance of research for the prevention of disease The diseases in which the testatrix was most interested were those that cripple or disable in childhood

Dr R A McCance Sidney Sussex College, has been appointed to the Pinsent Darwin Studentship in mental pathology

THE Ella Sachs Plotz Foundation is at present assisting research on problems in medicine or surgery, especially group researches on a single problem, for example for the past five years the general subject of nephritis, and to a lesser extent internal secretion and infection, have been given special consideration Twenty one grants were made during 1928, of which thirteen were to workers outside the United States Applications for grants to be held during 1929–30 must reach the secretary of the executive committee, Dr Joseph C Aub, Huntington Memorial Hospital, 695 Huntington Avenue, Boston, Mass, before May 15

Calendar of Patent Records

January 27, 1778 One of the many improvements in the water closet was due to Joseph Bramah who was granted a patent for his 'valve' closet on Jan 27, 1778 Bramah's was not only the pioneer in this type of closet but it also remained superior in its action to all the many inventions in the same class that followed it The modern water closet was first described by Sir John Harington in his "Metamorphosis of Ajax," published in 1596, many years before it came into general use

January 28, 1589 —The saltpetre monopolies of Elizabeth and James I are notorious from the fact that it was partly the abuse of their privileges by the saltpetre men appointed by the various patentees that led to the popular agitation against monopolies and ultimately to the Statute of Monopolies of 1623 but there was at the time a clear case for the establishment of a national source of supply for the manufacture of gunpowder One of these patents was that granted to George Evelyn, Richard Hills and John Evelyn on Jan 28, 1589 Certain districts, notably London, being already covered by other grants were excluded from its operation, but in 1591 a new grant was issued to the Evelyns that gave them a virtual monopoly George Evelyn was the grandfather, and John Evelyn the uncle of the diarist

January 28, 1724 The faking of expensive materials is not peculiar to the present day On Jan 28, 1724, a patent was granted to Robert Redrich and Thomas Jones "as well for staining, veining spotting, clouding, damasking, and otherwise imitating the various kinds of marble, porphry, and other rich stones and tortoiseshell, on wood stone and earthenware and all and every such goods, wares, utensils, and things, as are cut, made, or fashioned thereout"

January 28, 1832 —Steel pen nibs were known early in the last century but they were not extensively used until James Perry who had been making them from 1819 onwards, introduced the use of cross slits and apertures between the shoulder and the point This construction he patented on Jan 28 1832 The firm of Perry and Co was founded in 1829

January 30, 1808 – The first band saw was patented in England by William Newberry on Jan 30 1808, but it was thirty years and more before it came into practical use, and it was in France where it was fully developed The two French patents of Mdlle Crespin (1846) and M Perin (1853) may be regarded as the foundation of the modern band saw

February 1, 1800 One of the earliest patents for a screw propeller for ships was that granted to Edward Shorter on Feb 1 1800, for what he called a 'perpetual sculling machine' probably intended to enable large vessels to be manœuvred in a calm Two or more blades similar to the sails of a windmill were mounted on a spar proceeding from any convenient part of the stern of the vessel obliquely downwards until its end dipped into the water, a buoy being provided to prevent it dipping too far The spar was connected by a Hooke universal joint to a horizontal shaft, to which motion could be given by the capstan worked by man power or by a steam engine By moving the spar transversely the ship could be steered The invention is said to have been successfully tried on H M Ships *Dragon* and *Superb*

February 3, 1818 —The patent for Jeremiah Chubb's original 'detector' lever lock is dated Feb 3, 1818 The special feature of this lock was the use of a 'detector' device which came into action immediately if a wrong key with too long a bit were used in an attempt to open the lock, and effectively blocked the bolt until re set by its proper key

Societies and Academies.

LONDON

Royal Society, Jan 17 —**A S Eddington** The charge of an electron (see p 138 of this issue) —**R H Fowler** The thermionic emission constant A Nordheim's theory of the emission coefficient of electrons from metals is used to explain the remarkable relation between the constants A and χ of the thermionic emission formula, first recorded by O W Richardson and recently reformulated by Du Bridge This theory regards the emission as due to the passage of electrons through simple surface potential steps and double layers to be calculated according to the wave mechanics —**J A Gaunt** The triplets of helium —**G Temple** The tensorial form of Dirac's wave equations Darwin's transformation of Dirac's wave functions is incompatible with the theory of relativity Dirac's wave equations are cast into tensorial form, from which are deduced the Lagrangian function, the charge and current tensor the magnetisation and polarisation tensor, some associated quadratic invariants —**H M Macdonald** The reflection and transmission of electric waves at the interface between two transparent media **D K Bhattacharyya** On the analysis of the first spark spectrum of sulphur The data of Eder and Valenta between λ3028 to λ5819, and certain observations of Keeler and Lockyer regarding the occurrence of S^+ lines in stellar spectra, are used The spectrum in the red region up to λ7715 was also photographed, using neocyanine plates and a Wood type of discharge tube A band system in the red, seemingly analogous to atmospheric bands of oxygen has been found —**J S Foster** Effect of combined electric and magnetic fields on the helium spectrum Parallel electric and magnetic fields are applied to a helium source, and the light analysed by a prism spectrograph of high dispersion The effects in the parhelium and orthohelium spectra are clearly additive in the sharp and principal series and for the components of the diffuse lines which are resolved The magnetic separation is independent of the magnitude of the Stark effect —**R W B Pearse** The ultraviolet spectrum of magnesium hydride (1) In addition to the well known visible (α) band system, two others a β system, represented by a strong band at λ2430 and a γ system covering the range λ5500 λ2300, have been found in the ultra violet —**J S Foster** and **W Rowles** Patterns and Paschen Back analogue in the Stark effect for neon In an attempt to determine Stark patterns in neon, 150 lines were examined by the Lo Surdo method in fields as high as 140 kv /cm An appreciable number of the diffuse and combination lines have a new pattern —**J K L MacDonald** Stark effect in a violet region of the secondary spectrum of helium Effects for twenty lines are observed in the region 3980 4080 A The Lo Surdo type of discharge tube is used displacements are measured at a field strength of 95,000 volts per cm Certain apparently complex effects are resolved into simple displacements of closely lying lines —**J S Foster** and **M L Chalk** Relative intensities of Stark components in hydrogen A report of a quantitative investigation of the relative intensities of the stronger Stark components in the first four members of the Balmer series In all cases the results agree within experimental error with the new calculations by Schrödinger —**O R Baldwin** The relativity theory of divergent waves The solution given by Einstein for the general problem of the propagation of gravitational waves was used by Eddington to find the solution for waves created by a spinning rod An attempt is now made to discover all the non spurious waves of the same general character at infinity as Eddington's —**G W C Kaye** and **W F Higgins** The thermal conductivity of solid and liquid sulphur The temperature range was 20° C 210° C A 'plate' method with a small temperature drop across the specimen was used —**S Barrett** and **C P Stein** On bromine chloride From spectrophotometric observations on the colour changes on mixing carbon tetrachloride solutions of bromine and chlorine, the two halogens give an equilibrium concentration of bromine monochloride The formation of a chemical compound between them is further indicated by the appearance of a new ultra violet absorption band with its maximum at 3700 A, peculiar to the mixtures, and also by the fact that the colour change in carbon tetrachloride solution takes an appreciable time —**C W Gibby**, **C C Tanner**, and **I Masson** The pressure of gaseous mixtures (2) The compressibilities up to 125 atm, of helium, hydrogen, and ten mixtures of the two, at 25° and of each pure gas and an equimolecular mixture at seven temperatures from 25° to 175° have been measured **J Charlton** and **C A Lea** Some experiments concerning the counting of scintillations produced by alpha particles (Parts 1 3) (1) Determination of the smallest amount of luminous energy perceptible by the eye (2) Determination of the efficiency of the transformation of the kinetic energy of the α particle into radiant and luminous energy for various zinc sulphides (3) Investigation of the way in which the number of scintillations observed is affected by the numerical aperture of the optical system used

Geological Society, Dec 19 —**W J Pugh** The geology of the district between Llanymawddwy and Llanuwchllyn (Merioneth) The rocks belong to the Bala and the Valentian Series There are important lateral changes within the Bala Series, and these reveal the transition from the succession described at Corris and Dinas Mawddwy to that around Bala The Bala rocks become more arenaceous and more calcareous from south to north, and this general change in lithology is accompanied by a gradual increase in the number and variety of shelly fossils Individual rocks are traced from the south to the Bala district, and direct correlation is made between rock groups represented by very distinct facies in the different districts The district is situated on the eastern flank of the Harlech Dome, and the rocks strike from south south west to north north east They dip east south eastwards, but there is some minor folding There are important strike faults, which conceal parts of the succession in certain localities The rocks are highly cleaved The strike of the cleavage planes is approximately parallel to the strike of the strata, but the direction of cleavage dip is variable

PARIS

Academy of Sciences, Dec 26 —**Paul Appell** On certain invariants —**Charles Moureu, Charles Dufraisse**, and **Pierre Laplagne** Autoxidation and antioxygen action The catalytic properties of silicon boron, and their derivatives Details of results obtained with ten silicon compounds and six boron derivatives with some typical curves —**J B Charcot** An arrangement allowing acoustic depth sounding in the polar regions Description of a modified Marti recorder and of results obtained by its use —**O Borůvka** A class of minimum surfaces in a five dimensional space with constant curvature —**Z Horák** The curvature of non holonome varieties —**L Pirot** Some determinations of the deviation from the vertical by means of the prism astrolabe Results of observations made at Fort de-France (Martinique), Pernambuco (Brazil), Lorient, Quiberon, and Brest —**J Errera** Molecular associa-

tions The relations between the viscosity of binary liquid mixtures and the polarity of the molecules of the constituents The following conclusions are drawn from available data when one of the components is dipolar and the other non polar, the viscosity curve, if not a straight line, is always concave When this curve is convex, the two components are always dipolar —**A Turpain** and **de Bony de Lavergne** The magnetic field and Brownian movement —**Maurice Curie** and **Adolphe Lepape** The dielectric cohesion *of the rare gases Bouty's experiments with helium*, neon, and argon were repeated with purer material, and krypton and xenon were also examined In the series neon, argon, krypton, and xenon, the dielectric cohesion increases with the atomic number —**L Goldstein** Some difficulties in the spontaneous emission of radiation —**J Cayrel** The effect of a magnetic field on the electrical resistance of a contact —**G A Beauvais** Very short waves The short waves described had a wave length of 16 20 cm They were reflected by parabolic and plane mirrors according to the laws of optics —**Henri Belliot** The development of inverted or solarised photographic plates *after fixing* —**E Carrière** and **P Castel** The experimental study of the transformation of chromates into bichromates —**J Orcel** and **S Pavlovitch** The microscopic characters of the oxides of manganese and of the natural manganites —**P Sédallian, A Leulier, and Mme Clavel** The distribution and stability of the antigen properties of the diphtheric toxin The rôle of the non specific colloids

Official Publications Received

BRITISH

Department of Scientific and Industrial Research Report of the Building Research Board with the Report of the Director of Building Research *for the Year 1927* Pp viii+192+10 plates (London H M Stationery Office) 3s net.

Indian Central Cotton Committee Technological Laboratory Bulletin No 17 A Note on the Early *History of Cotton* By A N Gulati and Arthur Innes Turner (Technological Series No. 12) Pp 10 (Bombay) 8 annas

The Scottish Forestry Journal being the Transactions of the Royal Scottish Arboricultural Society Vol 42 Part 2 October Pp 35 110+28 18 (Edinburgh) 7s 6d.

Ollscoil Na h Eireann (The National University of Ireland) Calendar for the Year 1928 Pp viii+827+465 (Dublin)

Ministry of Health Circular 930 Circular as to the Contents and Arrangement of the Annual Reports of Medical Officers of Health for 1928 Pp 11 (London Ministry of Health)

The Journal of the Institution of Electrical Engineers Edited by P F Rowell Vol 67 No 384 *December* Pp 124+xxxiii (London E and F N Spon Ltd) 10s 6d

Transactions of the Royal Society of Edinburgh Vol 56 Part 1 No 5 On some points in the Anatomy and Habits of the Lophogastrid Crustacea By Dr S M Manton Pp 103 110+3 plates (Edinburgh Robert Grant and Son London Williams and Norgate Ltd) 3s

Air Ministry Meteorological Office London Southport Auxiliary Observatory (The Fernley Observatory of the Corporation of Southport) Annual Report and Results of Meteorological Observations for the Year 1927 By Joseph Baxendell Pp 28 (Southport The Fernley Observatory London Meteorological Office)

Scottish Marine Biological Association Annual Report 1927 28 Pp i (Glasgow)

Nyasaland Protectorate Report on some Diseases of Tea and Tobacco in Nyasaland By Dr E J Butler Pp 90+4 plates (Zomba Department of Agriculture London Colonial Office)

Memoirs of the Indian Meteorological Department Vol 2 Part 2 Summary of Indian Rainfall for the Fifty Years 1875 1924 Pp iii+1 108 (Calcutta Government of India Central Publication Branch) 8 rupees 13s 6d

The Deeside Field Issued under the Auspices of the Deeside Field Club Fourth Number Edited by J B Philip Pp vi+88+28 plates. (Aberdeen) 3s 6d.

FOREIGN

Bulletin of the Terrestrial Electric Observatory of Fernando Sanford, Palo Alto California Vol 5 Observations on Solar and Lunar Diurnal Variations of Earth Potential due to Changes in Distribution of the Earth's Surface Charge Including Two new Methods of recording such Variations, and on the accompanying Variations in the Atmospheric Potential Gradient for the Year 1927 Pp 26 (Palo Alto Calif)

Contributions from the Dudley Herbarium of Stanford University Vol 1 No 2 Preliminary Report on the Flora of the Tres Marias Islands By Roxana Stinchfield Ferris Pp. 32+4 plates. (Stanford University Calif Stanford University Press) 1 00 dollar

Proceedings of the United States National Museum Vol 73 Art 12 A Revision of the Lizards of the Genus Ctenosaura By Prof John Wendell Bailey (No 2738) Pp. 58+30 plates. (Washington D C Government Printing Office)

Department of Commerce U S Coast and Geodetic Survey Special Publication No 146 Radio Acoustic Position Finding Pp iv+62 (Washington D C Government Printing Office) 20 cents

Department of Commerce Bureau of Mines Coal in 1926 By F G Tryon O E Kiessling and L Mann (Mineral Resources of the United States Part 2) Pp x+419 585 (Washington D C Government Printing Office) 30 cents.

Conseil Permanent International pour l'Exploration de la Mer Rapports et Procès verbaux des Réunions Vol 50 Whales and Whale Foetuses Statistics of Catch and Measurements collected from the *Norwegian Whalers Association 1922-25* By Sigurd Risting Pp iii+122 (Copenhague Andr Fred Høst et fils)

Department of Commerce Bureau of Standards. Miscellaneous Publications No 88 Annual Report of the Director of the Bureau of Standards to the Secretary of Commerce for the Fiscal Year ended June 30 1928 Pp iv+46 (Washington D C Government Printing Office) 5 cents

Proceedings of the United States National Museum Vol 74 Art 3 New Fossil Early Fresh water Mussels from Deposits on the Upper Amazon of Peru By William B Marshall (No 2748) Pp. 7+1 plate (Washington D C Government Printing Office)

Section de Géodésie de l'Union Géodésique et Géophysique Internationale Publication spéciale No 2 Tables de l'ellipsoide de référence internationale adopté par l'Assemblée générale de Madrid le 7 octobre 1924 dans le système de la Division sexagésimale de la Circonférence Calculées sous la direction du Général G Perrier par E Hasse Pp 20+91 (Paris)

U S Department of Agriculture Farmers Bulletin No 1566 The Sorghum Midge with Suggestions for Control By C H Gable W A Baker and L C Woodruff Pp ii+10 (Washington D C Government Printing Office) 5 cents

Instituts scientifiques de Buitenzorg 's Lands Plantentuin Treubia recueil de travaux zoologiques hydrobiologiques et océanographiques. Vol 7 Suppl Livraison 2 Novembre Fauna Buruana Acari Von Dr A. C Oudemans Pp 3, 100 (Buitenzorg Archipel Drukkerij) 5 f

Obras completas y correspondencia científica de Florentino Ameghino Volumen 7 Los mamíferos fósiles de la República Argentina Parte 2 Ungulados Edición oficial ordenada por El Gobierno de la Provincia de Buenos Aires Dirigida por Alfredo J Torcelli Pp 724 (La Plata Taller de Impresiones Oficiales)

R Osservatorio Astrofisico di Catania. Catalogo Astrofotografico Internazionale 1900 0 Zona di Catania fra le declinazioni +46 e +55 Vol 7 Parte 2a Declinaz da + 47 a + 54 ascens retta da 3h a 6h (Fascicolo N 50) Pp viii+36 Vol 8 Parte 2a Declinaz da + 3 a + ascens retta da 3h a 6h (Fascicolo N 58) Pp viii+39 (Catania)

Diary of Societies

FRIDAY JANUARY 25

BRITISH MYCOLOGICAL SOCIETY (London Meeting) (at University College) at 11 A M Miss D M Cayley Some Observations on Mycetozoa of the Genus *Didymium* A Chaston Chapman A New Species of *Didymium* —Miss E H M Farries An Investigation on the Metabolism of *Nematospora Gossypii* Ashby and Nowell — M Mitra *Hyalopus parasiticus* Dast as a Parasite on Cotton Seedlings and Guava Fruit — Dr A Smith Observations on *Puccinia Menthae* Pers

INSTITUTION OF ELECTRICAL ENGINEERS (Irish Centre — Dublin) (at Gaiety Theatre Dublin) at 4 — H B Atkinson How Electricity does Things (Faraday Lecture)

ASSOCIATION OF ECONOMIC BIOLOGISTS (Annual General Meeting) (in Botany Lecture Room Imperial College of Science and Technology) at 5 — S G Tallents The Work of the Empire Marketing Board

PHYSICAL SOCIETY (at Imperial College of Science) at 5 — Prof C V Boys A Fused Quartz Pendulum Rod for Clocks — G W Sutton A Method for the Determination of the Equivalent Resistance of Air Condensers at High Frequencies — L Hartshorn The Measurement of the Anode Circuit Impedances and Mutual Conductances of Thermionic Valves

ROYAL SOCIETY OF MEDICINE (Disease in Children Section) at 5 — Dr F J Poynton and Dr A Moncrieff A Case of Mediastinal Teratoma in an Infant

ROYAL COLLEGE OF SURGEONS OF ENGLAND at 5 Sir Arthur Keith The Anatomy and Evolution of the Human Brain

INSTITUTE OF TRANSPORT (Manchester Liverpool and District Section) (at Liverpool) at 6 30 — C C Taylor The Reasons of Development of Road Transport in Recent Years

ENGINEERING AND SCIENTIFIC CLUB (Wolverhampton), at 7 — A C Baker C O Silvers and others Debate on Trams versus Buses

SOCIETY OF CHEMICAL INDUSTRY (Birmingham and Midland Section) (at Engineers Club Birmingham) at 7 — Prof W E S Turner Some Important Minor Constituents in Glass

INSTITUTION OF LOCOMOTIVE ENGINEERS (North Eastern Centre) (at Hotel Metropole Leeds), at 7 — J C Armstrong Pulverised Fuel Locomotive

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemical Section) at 7

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting) at 7 — J E Lea *Measurement of Coal Supplies in Small or Large Quantities*

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN at 7 — F T Usher Bromoil

WEST OF SCOTLAND IRON AND STEEL INSTITUTE (at Royal Technical College Glasgow), at 7 — J Mitchell The Manufacture of Iron and Steel Tubes

INSTITUTION OF ELECTRICAL ENGINEERS (North Eastern Students Section) (at Armstrong College Newcastle upon Tyne) at 7 15 — S Gibson The City of Winnipeg Hydro electric Power Station

BLACKBURN TEXTILE SOCIETY (at Bradford Technical College), at 7 30 — W Wilkinson Power Loom Pickers and Picking (Lecture)

Junior Institution of Engineers, at 7.30.—M J McCarthy Notes on Winches Derricks, and other Lifting Appliances used in Modern Building Construction

Royal Society of Medicine (Epidemiology Section), at 8.—Dr Ledingham, Dr G F Buchan and others Discussion on Vaccination Against Smallpox in the Light of Recent Experience

Institution of Production Engineers (at 83 Pall Mall), at 8.—L. H Pomeroy The Designer *versus* the Production Engineer

Royal Institution of Great Britain at 9.—Prof A C Seward The Vegetation of Greenland

SATURDAY January 26.

Institution of Municipal and County Engineers (Southern District) (at Town Hall Oxford), at 11.15 a.m.—H V Overfield and others Discussion on Road Surfaces and a Standard of Maintenance.—W L Williams Notes on the Construction of a New Public Convenience

Institution of Municipal and County Engineers (Gateshead-on Tyne), at 2.45

Royal Institution of Great Britain at 3.—Dr E Cammaerts Flemish and Belgian Art (II) The Landscape

MONDAY, January 28

Cambridge Philosophical Society (in Cavendish Laboratory), at 4.30.—Sir Ernest Rutherford and Dr J Chadwick Energy Relations in Artificial Disintegration.—R. H Fowler An Analogy for Beams of Particles of a Reciprocal Optical Theorem due to Helmholtz.—Dr D R. Hartree The Distribution of Charge and Current in an Atom with Several Electrons Obeying Dirac's Equations.—N Feather and R R Nimmo The Distribution of Range of the α particles from Radium C and Thorium C'.—*To be communicated by title only*.—R. M Gabriel Some Further Results concerning the Integrals of Moduli of Regular Functions along Curves of Certain Types

Royal College of Surgeons of England at 5.—Prof A Evans Developmental Enterogenous Cysts and Diverticula

Institution of Electrical Engineers (Informal Meeting) at 7.—F C Raphael and others Discussion on Mains Testing

Institution of Electrical Engineers (North Eastern Section) (at Armstrong College Newcastle upon Tyne) at 7.—J L Carr Recent Developments in Electricity Meters, with particular reference to those for special purposes

Royal Society of Arts at 8.—Dr C H Lander The Treatment of Coal (Cantor Lectures) (II).

Medical Society of London at 8.—Dr E Spriggs and others Discussion on Starvation in Treatment

Royal Society of Medicine (Odontology Section), at 8.—G B Pritchard The Origin and Prevention of Gingivitis.—A T Pitts Two Compound Composite Odontomata Dr J Kingston Barton The Prevention of Diseases of the Teeth in Children W Rushton The Use of Cement Linings in Cavities

University of Birmingham Chemical Society.—Dr Twiss Sulphur and Rubber

Institution of Electrical Engineers (Western Centre) (at Bristol).—H B Atkinson How Electricity does Things (Faraday Lecture).

Todmorden Textile Society (at Todmorden).—B Sutcliff Steam Engine Testing (Lecture).

TUESDAY January 29

Royal Institution of Great Britain at 5.15.—Prof J S Huxley Evolution and the Problem of Species (I).

Institute of Engineering Inspection (at Royal Society of Arts), at 6.30.—B P Dudding Errors in Testing Bulk Supply by Random Selection

Electrical Association for Women (at 15 Savoy Street) at 7.—F W Purse How Electricity is Generated at West Ham (Lecture)

Institution of Electrical Engineers (Scottish Centre) (Informal Meeting) (at North British Station Hotel Edinburgh), at 7.—E Seddon Recent Extensions to Portobello Power Station

Institution of Electrical Engineers (North Midland Centre) (at Hotel Metropole, Leeds), at 7.—J Wright and C W Marshall The Construction of the Grid Transmission System in Great Britain

Royal Photographic Society of Great Britain (Scientific and Technical Group), at 7.—F F Renwick Dr T Slater Price and others Discussion on Fixation

Institute of Chemistry (Bristol and S.W Counties Section) (at Bristol University) at 7.30.—E Russell Some Toxicological Cases

Sheffield Metallurgical Association (at Sheffield), at 7.30.—Prof F C Lea The Influence of Surface Conditions and Internal Stresses on the Physical Properties of Cold worked and Quenched and Tempered Steels, with Particular Reference to Fatigue Resistance

Royal Anthropological Institute (Anniversary Meeting), at 8.30.—Prof J L Myres Presidential Address

Manchester Athenæum Textile Society (at Athenæum Manchester).—Dr Urquhart Cotton and Moisture (Lecture).

WEDNESDAY, January 30

Royal College of Surgeons of England, at 5.—Prof G E. Gask The Treatment of Malignant Disease by Radium with Demonstration of Patients who have been Treated

Institution of Civil Engineers (Students Meeting), at 6.30.—H G Cousins Design and Construction of Victoria House

Liverpool Engineering Society (at The Temple Liverpool), at 6.30.—J Austin Water Tube Boilers *versus* Scotch Boilers.

North East Coast Institution of Engineers and Shipbuilders (Graduate Section) (at Bolbec Hall Newcastle upon Tyne) at 7.15.—B Reed Locomotive Power and Proportions

Halifax Textile Society (at White Swan Hotel, Halifax), at 7.30.—C T Hobson Short-time its Effects and how to cost it (Lecture).

Royal Society of Arts at 8.—G Fletcher The Shannon Scheme and its Economic Consequences.

Glasgow Royal Philosophical Society (207 Bath Street, Glasgow), at 8.—Prof W Kerr Vibration

THURSDAY, January 31

Royal Society at 4.30.—Prof S. Chapman On the Theory of the Solar Diurnal Variation of the Earth's Magnetism.—Dr G M B Dobson, D N Harrison, and J Lawrence Measurements of the Amount of Ozone in the Earth's Atmosphere and its Relation to other Geophysical Conditions.—Prof S Chapman and J M Stagg On the Variability of the Quiet-Day Diurnal Magnetic Variation at Eskdalemuir and Greenwich.—L H Gray The Absorption of Penetrating Radiation.—*To be read in title only*.—R. d'E. Atkinson The Probability of Excitation by Electron Impact.—N W McLachlan Pressure Distribution in a Fluid due to the Axial Vibration of a Rigid Disk.—J D Cockcroft Skin Effect in Rectangular Conductors at High Frequencies.—L Rosenhead Systems of Line Vortices in a Channel of Finite Breadth.—Prof T P Hilditch and N L. Vidyarthi (*a*) The Products of Partial Hydrogenation of some Higher Polyethylenic Esters (*b*) The Products of Partial Hydrogenation of some Higher Monoethylenic Esters.—P K Kichlu and D P Acharya Infra red Radiations of Active Nitrogen.—Prof T H Havelock The Vertical Force on a Cylinder in a Uniform Stream.—R. C J Howland Stress Systems in an Infinite Strip.—A. H Wilson Perturbation Theory in Quantum Mechanics

Royal Institution of Great Britain, at 5.15.—Sir William Bragg The Early History of X Rays (I).

Biochemical Society Birmingham University, at 5.30.—Chemo and Radio Therapy (Student Papers).

Royal Aeronautical Society (at Royal Society of Arts), at 6.30.—W S. Farren Monoplane or Biplane?

Imperial College Chemical Society (in Main Chemistry Lecture Theatre Royal College of Science) at 7.—Dr T Slater Price Some Problems of Photographic Research

Institution of Mechanical Engineers (Manchester Branch). H I Guy Modern Development in Steam Turbine Practice

FRIDAY, February 1

Andersonian Chemical Society (at Royal Technical College Glasgow) at 8.15.—Dr R Hay Manufacture of Sulphuric Acid by the Contact Process

Royal Sanitary Institute at 5.—F R. Humphreys and others The Civilian Population and Chemical Warfare

Royal College of Surgeons of England at 5.—Prof C A Pannett Local Anæsthesia in the Surgery of the Upper Abdomen

Philological Society (at University College) at 5.30.—Prof V G Childe Philology and Archæology

Institution of Mechanical Engineers, at 6.—Prof A S. Eddington Engineering Principles in the Machinery of the Stars (Thomas Hawksley Lecture)

Society of Chemical Industry (Manchester Section) (jointly with Liverpool Section) (at Engineers Club Manchester), at 7.—Dr F Challenger The Sulphur Compounds of Shale Oil and Petroleum

Institution of Electrical Engineers (Meter and Instrument Section) at 7.—J L Carr Recent Developments in Electricity Meters with particular reference to those for special purposes.

Royal Photographic Society of Great Britain (Pictorial Group—Informal Meeting) at 7. P Fripp Some Aspects of Craftsmanship.

Junior Institution of Engineers (Informal Meeting) at 7.30.—T H Cross Notes on Road Construction

Textile Institute (Lancashire Section) (jointly with Nelson Textile Society) (at Nelson), at 7.30.—O S Hall The Economic Aspect of some Developments in the Textile Industry (Lecture).

Royal Society of Medicine (Anæsthetics Section) at 8.30.—Dr R. D Lawrence Post operative Acidosis

Royal Institution of Great Britain at 9.—Prof J L Myres Geometrical Art in S.E Europe and Western Asia.

SATURDAY February 2

Royal Institution of Great Britain at 3.—Dr E Cammaerts Flemish and Belgian Art (III) Genre Painting

PUBLIC LECTURES

SATURDAY January 26

Horniman Museum (Forest Hill), at 3.30.—H Harcourt The Lure of India

MONDAY January 28.

King's College of Household and Social Science at 5.15.—Sir Robert Witt Dutch Art

University of Leeds at 5.15.—Prof A Holmes Radioactivity and Geological Time

East Anglian Institute of Agriculture (Chelmsford), at 7.—Dr H E Woodman The Conservation of Young Grass for Winter Feeding as a Protein Concentrate.

Sir John Cass Technical Institute at 7.—F S. Sinnatt Coal Carbonisation Theory and Practice (Introductory Lecture).

University of Leeds at 8.—Prof J R R Tolkien Celts and Teutons in Early Times

TUESDAY, January 29

University College at 5.30.—Prof Karl Pearson A New Theory of Progressive Evolution

THURSDAY, January 31

Bedford College for Women at 5.15.—H V Lanchester Indian Architecture

East London College, at 5.30.—Prof R Robinson Some Aspects of Polarity Theories in Organic Chemistry

FRIDAY February 1

London School of Economics and Political Science, at 5.—C E. R Sherrington The Steam Railways and the Localisation of Industry in the Nineteenth Century

SATURDAY February 2

Horniman Museum (Forest Hill), at 3.30.—Miss M A Murray The Ancient Egyptian Potter and his Clay

SATURDAY, FEBRUARY 2, 1929

CONTENTS

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Fundamental Research in Chemical Technology

INDUSTRIAL research has of late been much before the public eye, and in consequence an appreciation of its utility, if not of its methods or its meaning, has become general, even commonplace Moreover, the public has learned to look to the universities for the nurture of that kind of investigation which may equally be termed profitable invention or pure research, according to the point of view of the observer Intensive and accurately directed attacks on specific industrial problems, organised by technical men, have scored many notable successes and made important contributions to general scientific knowledge With a single industrial aim in view, however, the tendency has frequently been to ignore side tracks, whether or not they might lead to a broad highway of advance, and to reach the goal in ways that commend themselves to business men as economically desirable One would say nothing whatever to disparage or discourage this type of research Resting on fundamental bases usually already in existence—frequently on pillars which have been slowly and laboriously built up in the intellectually invigorating but financially rarefied atmosphere of a university—it has gone far towards consolidating the industrial position of Great Britain in the changed conditions of a post War world

It is therefore well to have in mind the character and the quality of the work which is going on among the foundations of the industrial edifice During the past sixteen years there has, for example, been gradually growing up at the Imperial College of Science and Technology, South Kensington, a school of fuel technology and combustion research, chemical engineering and electro chemistry (together forming the Department of Chemical Technology), of which the British Commonwealth may well be proud Directed by Prof W A Bone, with the assistance of Prof J W Hinchley (professor of chemical engineering) and Capt G I Finch (assistant professor of electrochemistry), and hitherto supported without any public appeal by the resources of the College supplemented by generous donations from external sources—an achievement of no mean order, since the financial provision required for buildings and equipment alone has already amounted to some sixty thousand pounds—it has now reached a condition in which, after patient preparation, it is on the point of launching a concerted attack on the complex problems presented by reactions between

gases under extremely high pressures Little indeed is known concerning the domain to be explored, but its study elsewhere in one particular direction, namely, the catalytic interaction of hydrogen and nitrogen, has already resulted in the establishment in Great Britain of a great new chemical industry, comparable with that which originated from similar researches in Germany further, Prof Bone's own work with pre explosion pressures up to 200 atmospheres or so has completely dispelled any reasonable doubt as to whether the excursion justifies the labour and cost which it must involve

An example of the unexpected behaviour of gas mixtures when exploded at these pressures, in future to be regarded as moderate only, is significant It will be appreciated that, apart from chemical factors and the influences of temperature and pressure, other considerations such as radiation effects have to be taken into account in interpreting the experimental results obtained in the study of gas reactions under pressures higher than those normally employed Hence, by the activation of molecules, unexpected new reactions may play a considerable part in the changes which may be followed under such conditions In point of fact, Prof Bone and his collaborators have already found that whilst the replacement of even small amounts of carbon monoxide in admixture with air by hydrogen has a very marked influence in accelerating the rise of pressure on explosion, nitrogen retards the attainment of maximum pressure to a surprising degree , moreover, less pressure is developed, and the subsequent cooling is retarded Evidently, much of the radiation emitted by combustion of the carbon monoxide had been absorbed by the nitrogen (which thereby became activated) and afterwards liberated as heat

The question of the effect of the presence of moisture on the combustion of carbon monoxide is also one to which a considerable amount of attention has been devoted Spectroscopic studies of flames of mixtures of carbon monoxide with hydrogen, and experiments on the relative ease of ignition of partly dried mixtures of carbon monoxide with oxygen, have led to the view that undried carbon monoxide interacts simultaneously with oxygen and with water molecules , moreover, the effect of pressure in overcoming the difficulty of causing a dry mixture of carbon monoxide and oxygen to burn is such as to suggest that at high initial pressures the former is the sole course of the reaction On the other hand, in an ordinary water-gas flame the combustion is almost exclusively indirect, and in either case the probability of some degree of activation or ionisation of the reacting gases cannot be excluded

Although Prof Bone is actively developing investigation into certain catalytic reactions, and has designed and had built apparatus with the view of following up results which he has already obtained, his principal aim at present is to extend his fundamental studies of gaseous combustion and explosion in such a manner as would, but a few years ago, have been regarded as beyond the range of practical engineering politics The investigations, it must again be emphasised, are of an essentially fundamental character , whilst the results which will accrue can scarcely fail to be of major significance in modern practice, the programme will not be confined to immediate needs, or be conceived in narrow terms The tender plant of a new technique, almost a new science, will be encouraged to develop, to blossom, and to bear fruit under conditions which provide the best possible opportunities for healthy existence and natural growth Such conditions include the provision of highly trained specialists to lead the teams ' of researchers, the design and construction of new and costly apparatus, and—for the work is not without risk—ample space and especially appropriate buildings The nucleus of the staff, thanks to Prof Bone and his colleagues, is ready , a substantial portion of the new apparatus required for the experiments in immediate prospect has recently been constructed at a cost of some £3300 and as much work is already in progress as can safely be conducted in the limited accommodation offered by the uncompleted buildings of that department of the Imperial College That its activities, closely related as they are to the needs of the great industries of the mother land, should not be confined within metropolitan or even insular boundaries, is only to be expected

The support which responsible commercial organisations have accorded, and continue to grant, to this department of the Imperial College is perhaps itself proof of a realisation that independence of thought and of action, such as is characteristic of the university and is associated with freedom in the exchange of views and ideas, is not at variance with aspirations and considerations necessarily arising out of the hard facts of an industrial situation It is, after all, a wisely invoked co operation, rigid here and elastic there, between science and industry which best lubricates the wheels of progress without clogging their differential gear

The Conductivity of the Atmosphere

The Electrical Conductivity of the Atmosphere and its Causes By Prof Victor F Hess Translated from the German by L W Codd Pp xviii + 204 (London Constable and Co, Ltd, 1928) 12s net

PROF VICTOR HESS'S book on the conductivity of the atmosphere was published in German in 1926, and was appreciated as the first adequate account of the subject A hearty welcome to the English edition is assured The work deals in orderly fashion with the measurement of conductivity, with the nature of the ionisation to which conductivity is due, with the causes which produce ionisation, and with the processes by which ions are destroyed Of the causes which produce ionisation, the most important is the highly penetrating radiation discovered by Hess himself, and to many readers the section dealing with this radiation will prove the most interesting part of the book The clear way in which the story is told and the restraint with which the author has abstained from spoiling the balance of the book will be admired, but we may regret that he has not gone into more detail, especially with regard to his own pioneer work

The first step towards the discovery of the highly penetrating radiation was taken in 1901, when it was announced by Elster and Geitel, and almost simultaneously by C T R Wilson, that enclosed air was continuously ionised By 1903 it was known that the ionisation was largely due to radiation which could be cut off by heavy screens surrounding the enclosure By 1908 it had been demonstrated that a large part of this penetrating radiation came from the ground, but observations made at such places as the top of the Eiffel Tower had indicated that the radiation did not decrease with increasing height so rapidly as had been anticipated In 1910 the first observations in balloons were published Hess not only improved the apparatus used for measuring the penetrating radiation in a balloon, but also made no less than ten ascents, the highest being to 5400 metres He found in 1911 that there was a slight decrease of the total radiation up to 1000 metres, then a slow, and finally a rapid increase of the radiation From this discovery he deduced the existence of a hitherto unknown radiation entering the atmosphere from above and of greater hardness than the known gamma rays Hess's observations were immediately confirmed by Kolhörster, whose highest ascent reached 9 km above ground

In the last few years there has been great activity in the investigation of the ultra gamma radiation in many parts of the world, notably in America It is generally believed that this radiation comes from outer space with no preference for any special parts of the sky Hess quotes the experiments of Kolhörster made on a glacier near the Jungfrau during three summers, from which it appeared that there was a diurnal variation with an amplitude of 15 per cent The maximum seemed to coincide with the zenith position of the Milky Way and neighbouring regions of the sky On the other hand, the latest observations,[1] those made by Steinke in the Engadine with improved apparatus, show no influence of stellar time Steinke's apparatus was sensitive enough for the influence of varying barometric pressure on the absorption of the ultra gamma radiation to be measured Clearly, the extension of measurements of the same order of accuracy to other latitudes is desirable It is to be noted that Hess still regards it as possible that the ultra gamma radiation is produced in the outer atmosphere of the earth in response to some stimulus from the sun He suggests that measurements of the penetrating radiation in the auroral zone would settle this question Less cautious philosophers are convinced that the radiation comes from distant space In his Trueman Wood lecture, Sir James Jeans says ' There is no reason to doubt that it originates just where it ought to, namely, in the great nebulæ In a sense this radiation is the most fundamental physical phenomenon of the whole universe " May we add that there is no reason to doubt that some day we shall have telescopes designed to give measurements of the ultra gamma radiation from individual nebulæ, measurements which will lead to new knowledge of the structure of the universe

Turning to the main subject of the book, we note that the conductivity of the air near the ground is such that the half time period for the dissipation of the charge on an exposed conductor is roughly 15 minutes The air at 9 kilometres conducts ten times as well The small ions to which the conductivity is due have but short lives Their usual fate is to be caught by their larger neighbours, the Aitken nuclei, within a minute after their creation

It is found that on land the small ions are mostly generated by radioactivity According to Hess's summary, the radium and thorium emanation in the air produce about 5 ions per c c per second,

[1] E Steinke, *Zs f Phys* 48 pp 647 689, 1928. Abstract by Hess, *Zs f Geophys*, 4, pp 121 123, 1928.

the α rays being the most effective The γ-radiation from the radioactive substances in the earth accounts for 3 ions per c c per second To the 8 ions produced by radioactivity must be added $1\frac{1}{4}$ produced by ultra gamma radiation, so that $9\frac{1}{4}$ ions per c c are produced each second alto gether in the cubic centimetre The most con spicuous variations in conductivity at one place are probably due to variations in the number of nuclei waiting to catch the small ions In a fog, the small ions are caught so quickly that the con ductivity assumes a very low value On the other hand, variations between localities may be asso ciated with the geological conditions which deter mine the radioactivity of the ground and of the emanation which is exuded from the ground The high potential gradient and low conductivity of the air near London may be attributed to the slight radioactivity of London clay as well as to the pollution of the atmosphere Hess points out that there is no part of the world for which the balance of ionisation is thoroughly known One factor has been observed by an investigator here, another there Observatories equipped to record all the elements simultaneously and continually are required

Whilst the ionisation over the land is mostly caused by radioactivity, that over the oceans is to be attributed to the ultra gamma radiation It is perhaps a mere coincidence that the effective ionisation is about the same over land and sea, where there are several ionising agencies, there is also an excess in the number of nuclei ready to absorb the ions

The important subject of the ionisation of the upper layers of the atmosphere is dealt with very briefly The introductory paragraph on the com position of the air in these upper layers requires revision already It is stated that the temperature of the atmosphere above 30 km is unknown, and the calculations made by Humphreys of the density at heights up to 120 km on the assumption of a uniform temperature of $-55°$ are quoted The higher density required by the Lindemann Dobson theory of meteors and by the records of ' abnormal audibility ' is not mentioned Recent discussions of the auroral spectrum lend no support to the doctrine that the atmosphere at 70-80 km and upwards consists chiefly of hydrogen The im portance of these comments lies in the fact that Hess gives a table of the conductivity produced by penetrating radiation The table depends on the assumed density of the air, and should therefore be used with great caution

The sketch of the part played by the Heaviside layer in the transmission of wireless waves is brought up-to-date, but there is no account of the evidence from terrestrial magnetism for the existence of such a layer This is the more remarkable, as it is mentioned that Balfour Stewart had "advanced a similar idea" in 1883, long before wireless telegraphy was thought of It is to be hoped that in another edition some account of the brilliant work of Schuster and Chapman in elaboration of Balfour Stewart's idea will be given

The book is a pleasure to read, not only on account of the clear exposition of the author, but also because of the smooth English of the translator The stimulus to the study of atmospheric electricity will be felt in many quarters

A work of this character has to be read backwards and forwards, and it is therefore particularly unfortunate that the publishers have seen fit to print across the top of every pair of pages the same heading—the electrical conductivity of the atmosphere Such a heading does not help anyone who is looking for details of some special part of the subject It is to be hoped that when the second edition is produced, the normal practice of varying the page headings from chapter to chapter will be followed F J W W

Classification of the Higher Ferns

The Ferns (Filicales), treated comparatively with a View to their Natural Classification Vol 3 *The Leptosporangiate Ferns* By Prof F O Bower Pp viii + 306 + 2 plates (Cambridge At the University Press, 1928) 30*s* net

IN a book of some three hundred pages, beauti fully produced and amply illustrated, Prof Bower has now given us his considered views on the classification of the higher ferns Both author and publishers are to be congratulated on this work, the former on his consistent treatment of a truly diffi cult subject which has long called for revision, and the latter on the dignity of the volume itself

With admirable open mindedness, Prof Bower tells us, in effect, that while as the work has advanced, the older classification has suffered many changes in the light of the facts of development, the new classification now offered is by no means final, but must be used as the point of departure for further research, from which may later emerge other conclusions than those now adopted Reluctantly one is forced to doubt the validity of old comprehensive genera of higher ferns, long accepted, as the evidence from development is laid open in the pages of this book, for the characters on which these

genera have stood provide, indeed, the only criteria readily available to the average worker in the field This, however, is inevitable to progress and we are given a new conception of affinity with loosened bonds, a wider view of the complexity of the problems of the ferns, and a readier understanding of the diverse origins of advanced organisms as a whole

The classification now offered is based in part on characters of development, many of which are observable by the laboratory worker alone and involving for their fuller appreciation an extensive knowledge of the intimate details of growth This also is inevitable to progress and must lead in time to more intensive study of the characters themselves, and, perchance to their widening or revaluation as knowledge of fern physiology is advanced 'To travel hopefully is better than to arrive," is the faith of the author, who aims at no finality in the new classification offered but seeks to stimulate further inquiry on every possible line

The general conception of the book is simple, in that it presents chapter by chapter, a brief and clear statement of the varied views on affinity which have been held for the genera considered A central genus is then chosen examined in detail of habit, adult structure, and reproduction, and revised in the light of sporangial development, form, and spore production The same principles are involved as in the preceeding two volumes, with which the reader must be fully familiar if the author's findings are to be grasped , for at many points the matter is condensed and argument on the significance of the characters considered is strictly avoided For this reason the book calls for intensive reading and might well have benefited by extended argument, for the characters of many of the genera considered are so varied—some being viewed as primitive and others as advanced—that a clear picture of the position of a genus can be readily obtained only by one familiar with the intricacies of the subject This is, however, of the nature of the case, as, for example, with the Pteroid ferns which have hairs or scales, solenostelic or dictyostelic conductive systems, open or reticulate venation, a double or single indusium, and may have the sporangial receptacle on the leaf margin or superficial with the sporangia spread in the Acrostichod manner

It is only when the reader has fully studied in detail the genera which the author has grouped round his central types that the true value of his method is apparent It is then seen that his aim is not to reduce the ferns to a ready scheme for identification, but to give the reader a fuller view of the plasticity of living things, which, though loosely akin, have each gone their own way in descent, and have attained a distinctive individuality which has not wholly masked their origin It is soon apparent that the characters of general anatomy are no longer to be expected to march abreast in the phyletic advance and that primitive features may persist or be lost at many points in the progression from the ancestral stock The spore bearing organs alone are then considered relatively conservative and trustworthy and to them the author s faith is mainly pinned Thus a sporangial mass of marginal origin may tend to pass to a superficial position in the development of the individual and to a greater extent in the race the order of sporangial development may be modified the form of the sporangia themselves may be in a state of change, and the spore output may not yet have settled temporarily to a stable condition The problem of the individual fern and its present state rather than its final resting place in a systematic scheme indeed become the themes of the book and the reader finally emerges from an intensive struggle with characters which have only relative values, with a truer appreciation of the expressions of life than that with which he entered on his study

Some eleven chapters are devoted to the Davalloid Pteroid Gymnogrammoid Blechnoid Dryopteroid, and Dipteroid ferns and each is closed by a well chosen bibliography Of these the chapters on the Gymnogrammoids and Blechnoids are intensely interesting, and to those who have worked with the cold systematic treatment of the older classification they are a revelation in evolutionary study

It is not to be expected that in a study such as this, which seeks to loosen affinities, all the organisms considered should find a ready place in a systematic scheme Accordingly, a series of genera, including *Cystopteris Acrophorus, Monachosorum Prosaptia, Deparia*, and *Salvinia* are treated apart in a chapter on uncertain affinities The treatment here is necessarily brief, and prefigures some later pronouncement when the field of fact is widened

The two final chapters are devoted to the summary of results and their bearing on evolutionary theory Here the author shows clearly that he views his study as indicating the present drift of evolution among the higher ferns rather than defining clearly their evolutionary history, for which he offers a probable picture of earlier events rather than a definite demonstration, for the fossil record is too uncertain and fragmentary One may do well to read these chapters in detail before the systematic study of the book is begun, as in them the viewpoint

of the author is beautifully expressed towards systematic study as a whole. It may truly be said that with the preceding volumes Prof. Bower has now given us a classical study on affinity, replete with suggestion for work on many lines, and marked by a power of expression which many will envy and admire.
J. McL. Thompson.

South African Desiccation and the Bushmen

The Kalahari and its Native Races: being the Account of a Journey through Ngamiland and the Kalahari, with a Special Study of the Natives in that Area. By Prof. E. H. L. Schwarz. Pp. 244 + 24 plates. (London: H. F. and G. Witherby, 1928.) 16s. net.

Lake Ngami has played a conspicuous part in the discussion whether South Africa is undergoing a progressive desiccation which threatens its whole future, or whether the climatic changes that have happened are temporary fluctuations. The late Prof. Schwarz, during his ten years' work on the Geological Survey of Cape Colony, realised the extent to which some parts of the country have been impoverished by drought. He devoted himself to the question of how this alarming process could be checked, and in 1918 published his well-known scheme for the diversion of water from the Zambezi into the great depressions of Lake Ngami and the western Kalahari.

In 1925, while on the Kalahari Reconnaissance Expedition, sent by the Government to investigate his proposals, Prof. Schwarz found the country suffering from floods, and he returned by canoe from the Victoria Falls to Lake Ngami, which was reoccupied by water, and down the Botletle River until it disappeared in the desert; he then, by an arduous waggon journey, crossed the Kalahari to the railway at Palapye. The book describes this journey, which is of special interest, as the country was then restored to the condition familiar from its description by Livingstone. "A country," says Prof. Schwarz, "that had resigned itself to the condition of permanent drought was for a time gladdened by the sound of rippling water on all sides" (p. 13). A valuable table summarises the history of Lake Ngami from 1760, when it was dry; during the period when it was a great lake, from 1813 to Livingstone's visit in 1849, when it had then begun to decline; from 1854 until 1861, when it held some shallow water surrounded by reeds; and from 1896 until 1922, when there was no water, and the lake-bed was a dry plain. The restoration of Lake Ngami is regarded as evidence of a cyclic climatic change. The account is conclusive that Africa is not threatened by progressive natural desiccation.

The volume describes important features in the geology of the country. The Zambezi Valley above the Victoria Falls is regarded as a recently made rift valley, seven miles wide, with fault walls 250 feet high, and to this valley is attributed the diversion of the Zambezi and formation of the Victoria Falls. The basin of Lake Ngami is described as also due to a subsidence bounded by faults of recent date.

Prof. Schwarz's work was always characterised by variety of interest and daring originality, and these features are shown in his interesting account of the Bushmen. Evidence is summarised to show that they ranged all through Africa, and into Asia, and it is claimed that some of the South African natives show Australian and Patagonian affinities. The Mongoloid features of some of them are attributed to settlements of Chinese in East Africa in the tenth and eleventh centuries. This view is supported by reference to the Ming pottery found in Kenya Colony, but it is adequately explained as brought by the Arabs, who had acquired it during the overland trade between China and the Persian Gulf. The migration of Malays to Madagascar is well established, but Prof. Schwarz claimed a Malay origin for the Makalaka who live at the normal end of the Botletle River, and of the Nyam Nyam of the Upper Nile. In regard to the Hereros, the claim is quoted that their matrilineal descent is due to their ignorance that man has anything to do with parentage, and a more reasonable explanation of that custom is adopted.

The book is a valuable contribution to the recent condition of South Africa by an exceptionally keen observer, who was never afraid of unorthodox deductions.

Our Bookshelf

Elements of Optical Mineralogy: an Introduction to Microscopic Petrography. By Prof. Alexander N. Winchell. Third edition, revised and enlarged. Part 1: *Principles and Methods.* Pp. viii + 238. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1928.) 17s. 6d. net.

Within the last few years there have been marked advances in petrographic microscopical technique, and Prof. Winchell, in the revised edition of his well-known text-book, has incorporated selected examples in a chapter entitled "Special Methods of Study." Under this heading he deals with the application of Fedorow methods to the study of thin sections, and in addition, the modern dis-

persion methods of refractive index determinations with immersion oils The former are now in almost universal use on the Continent, and have been found to be invaluable in the discrimination of plagioclase felspars The various adjustments of the universal stage are explained, and the author gives full instructions for the location and plotting of symmetry planes and other symmetry elements, bringing out in a very clear manner the extreme simplicity of the method

Dispersion methods are essentially an improvement on the ordinary immersion methods of refractive index determinations, the refinements not only increasing the accuracy but also decreasing the number of oils necessary With the double dispersion methods, only thirteen oils are necessary to cover the whole range of refractive indices, ordinarily requiring about sixty oils The theory depends on the fact that increase of temperature decreases the refractive index of a liquid, whereas that of a solid remains practically constant, and decrease of wave length of light increases the refractive index of a liquid to a much greater degree than that of a solid The single-dispersion method employs only the first, while the double dispersion method employs both The measurements for the case of quartz are given as an example of the latter, and, in addition, dispersion curves for thirteen liquids are supplied

The American Indian Frontier By Prof W C Macleod (The History of Civilisation Series) Pp xxiii + 598 (London Kegan Paul and Co, Ltd, New York Alfred A Knopf, 1928) 25s net

IN the classification of the subject matter of "The History of Civilisation" Series, Prof Macleod's book on the Indian frontier falls into the section entitled "Historical Ethnology," being the fourth to be so included That such a section should prove of great utility there is no question, though this is perhaps not the occasion to discuss whether the three volumes previously included conform strictly to its requirements, but there can be no two opinions as to the suitability for inclusion of Prof Macleod's book He surveys frontier relations between European and Indian from the Indian side of that border line, stressing the institutional changes from precedent conditions which have been brought about by contact and ending with an analysis of conditions as they are to day

Prof Macleod has had a highly complex question to consider, which has involved the examination of a vast mass of detailed evidence The Colonial policies, for example, of the different European nations involved, whether in war or in peace, are alone an enormous labour to disentangle, while trade relations, if not so extended or complex, entail a most difficult and tedious research Prof Macleod's book is a valuable contribution to ethnological and historical literature, but it is more than that It is a document which should serve as a guide and a warning in our relations with peoples of non European culture to day

Bibliography of Sponges, 1551–1913 By the late Prof G C J Vosmaer Edited by Dr G P Bidder and C S Vosmaer Röell Pp xii + 234 (Cambridge At the University Press, 1928) 15s net

WHEN G C J Vosmaer died in 1916, he left, all but completed, a monograph on the sponges of the Bay of Naples, on which he had been at work for more than thirty years Those familiar with the fine quality of his work anticipated great things from this monograph, and it is to be hoped that it may yet be found possible to publish it Meanwhile the piety of his widow, Madame Vosmaer Roell, and of his friend Dr G P Bidder, has led them to edit and publish as a separate volume the exhaustive "Bibliography of Sponges, 1551–1913," which he had prepared for the monograph

Lacking the final touches of the compiler, whom no editor, however painstaking, can perfectly replace, the bibliography, as Dr Bidder points out, has some imperfections, but they are not of a kind or magnitude likely to impair seriously its usefulness Like most Continental bibliographers, Vosmaer does not seem to have been aware of the rich store of bibliographical information contained in Mr B B Woodward's "Catalogue of the Library of the Natural History Museum" No one, however, will in the future attempt the serious study of sponges without this volume at his elbow, unless he be one of those younger biologists to whom Dr Bidder feelingly alludes, who "incline to cut themselves loose from the lengthening chain of literature, and to read nothing that has appeared more than twenty years ago" To these, a consideration of the concluding paragraphs of Dr Bidder's preface may be strongly recommended

A Textbook of Biochemistry for Students of Medicine and Science By Prof A T Cameron Pp x + 462 (London J and A Churchill, 1928) 15s net

PROF CAMERON'S book appears to be a useful addition to bio chemical literature, it provides an up to date and broad outlook on a subject which is advancing so rapidly that a chapter may become out of date even before it is printed The author feels that bio chemistry has its applications in other sciences besides physiology, and to break down some of the water-tight compartments which so often exist between them, has included chapters on the chemistry of immunology, on the utilisation of bio chemical processes in industry, and on the relationship of bio chemistry and pharmacology, in addition, chapters are devoted to comparative digestion, and to chemical actions brought about by moulds and bacteria In a future edition it might be advisable to amplify somewhat the sections on internal secretions and the vitamins, substances of immense importance to the animal economy

Although more suitable perhaps for the student of bio chemistry, the work could be read with profit by the medical student, and also by those who wish to be in touch with the latest developments of the subject Each chapter has a few references appended, chiefly to monographs or reviews, in which those interested can obtain the fuller information they may desire

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications]*

The Raman Effect with Liquid Oxygen, Nitrogen, and Hydrogen

IN some experiments we recently made to see if a Raman effect could be observed with homopolar molecules, we found that the spectrum of the light scattered by liquid air included six sharp and clearly defined lines not included in the irradiating light, which was that from the mercury arc The wave lengths of these lines wore approximately 4317 7 A , 4674 3 A , 5026 5 A , 4468 9 A , 4849 3 A , and 4980 3 A They with their frequencies are given below

Element	Exciting Radiation		Scattered (Raman) Radiation			Δν observed	Δν calculated from Band Spectra Data
	λ (A)	ν (vac)	λ	Int	ν (vac)	cm^{-1}	cm^{-1}
Oxygen	4046 6 4358 3 4358 3	24 705 22 938 22,938	4317 7 4674 3 5026·5	1 2 0	23 154 21 387 19 889	1552 1551 3049	1554 1554 3085
Nitrogen	4046 6 4358 3 4046 6	24 705 22 938 24 705	4468 9 4849 3 4980 3	1 00 0	22,371 20,616 20,073	2335 2322 4632	2331 2331 4633

The experiment was repeated with pure liquid oxygen and again with pure liquid nitrogen, and it was found that the wave lengths 4317 7 A , 4674 3 A , and 5026 5 A only were obtained with liquid oxygen, and the wave lengths 4468 9 A , 4849 3 A, and 4980 3 A only with liquid nitrogen The existence of two of the Raman lines with each liquid can be explained by supposing them to arise from irradiation by light of the two wave lengths 4358 A and 4047 A The frequency difference for the mercury line 4047 A and the Raman oxygen line 4317 7 A is 1552 cm^{-1}, and for the mercury line 4358 A , and the Raman oxygen line 4674 3 A is 1551 cm^{-1} With the nitrogen lines, the one, 4468 9 A , has a frequency difference with the mercury line 4047 A of 2335 cm^{-1}, and the other, 4849 3 A with the mercury line 4358 A , one of 2322 cm^{-1}

It would seem that a mean vibration frequency of approximately 1551 5 cm^{-1} was involved in the Raman effect with liquid oxygen and a mean vibration frequency of approximately 2328 5 in the Raman effect with liquid nitrogen

From the *Bulletin of the National Research Council*, vol 11, Part 3, No 57, on "Molecular Spectra in Gases," p 232, 1554 cm^{-1} is indicated as the primary vibration frequency of the oxygen molecule in its normal state, and 2331 cm^{-1} as that of the nitrogen molecule in its normal state The two quantum vibration state of oxygen would appear to be 3085 cm^{-1} and that of nitrogen 4633 cm^{-1}

Our results would suggest that the primary vibration frequencies are the ones involved in the production of four of the Raman lines observed by us The other two lines, it would seem, are produced by absorptions corresponding to the frequencies of the second vibration states of the two elements, for if with oxygen the exciting mercury line is taken to be 4358 A , the frequency difference between it and the Raman line at 5026 5 A is 3049 cm^{-1}, and with nitrogen, if 4046 6 A of mercury is taken as the exciting line, the frequency difference between it and the Raman line at 4980 3 A is 4632 cm^{-1}

In experiments with liquid hydrogen irradiated with light from the mercury arc, we found that in addition to the usual mercury lines there were included in the spectrum of the scattered light lines corresponding to wave lengths 4426 6 A , 4473 1 A , and 4863 5 A These with their frequencies are given below

Element.	Exciting Radiation		Scattered (Raman) Radiation			Δν observed	Δν calculated from Band Spectra Data
	λ (A)	ν (vac)	λ (A)	Int	ν (vac)	cm^{-1}	cm^{-1}
Hydrogen	4358 3 4358 3 4046 6	22 938 22,938 24 705	4426 6 4473 1 4863 5	2 4 1	22 584 22,350 20,556	354 588 4149	347 578 4159

By the use of suitable light screens, it was found that 4426 6 A and 4473 1 A were excited by the radiation 4358 3 A , and 4863 5 A by radiation 4046 6 A The available data on the band spectra of hydrogen enable one to show that 347 cm^{-1} and 578 cm^{-1} are the frequencies corresponding respectively to $0 \rightarrow 2$ and $1 \rightarrow 3$ rotational transitions for hydrogen molecules in the zero vibrational state It can be shown, too, that 4159 cm^{-1} is the frequency of a $0 \rightarrow 1$ vibrational transition for hydrogen molecules in the zero vibrational state From the numbers given in the table, it will be seen that the Raman effects we observed with hydrogen were due to these three transitions

The results are interesting in that they constitute a series of violations of generally accepted selection rules They show (1) that Raman effects can be obtained with homopolar molecules, (2) that part of the energy of light quanta can be taken up directly as rotational energy, the balances appearing as quanta degraded in frequency, and (3) that two quantum rotational transitions can be demonstrated in connexion with light scattering phenomena

The results of the experiments, moreover, constitute experimental proof of the correctness of Dennison's view that hydrogen at low temperatures must be regarded as a mixture of two effectively distinct sets of molecules, symmetrical and antisymmetrical According to our results, we have in liquid hydrogen (1) some molecules in the zero vibrational and zero rotational states, and (2) others in the zero vibrational and first rotational states Our intensity measurements show that there were in the latter states considerably more (about twice as many) molecules than in the former ones The 'distinctness' of the two states is emphasised by the fact that no Raman effects were obtained corresponding to $0 \rightarrow 1$ or $1 \rightarrow 2$ rotational transitions

J C MCLENNAN
J H MCLEOD

University of Toronto, Dec 20

The Understanding of Relativity

MAY I have space for a last letter about the difficulties of the ordinary man with respect to relativity and kindred puzzles? Of course there is such a thing as relativity We take it into account in daily life But I cannot believe that modern mathematicians have overthrown fundamental axioms of thought Such dictionaries as I have consulted define parallel lines as those which keep equidistant from each other But a spiral wound around a straight line might keep equidistant, and yet not be parallel Presumably parallel lines are those which keep equidistant on the

same plane If that be true, lines of longitude are not parallel for even an inch But if lines were drawn from points at a given distance on opposite sides of one pole to points in similar relation to the other pole, they would be parallel—like lines of latitude drawn equidistant from the equator To define parallel lines as those which meet at infinity is merely to confuse the learner by giving a contradictory meaning to an old word It may be that lines which *seem* parallel in perceptual space are found to be convergent, when more than three dimensions are brought into consideration, but that proves not that a fundamental axiom of thought (that things cannot both be, and not be, at the same time) is wrong, but only that our senses deceive us

I write as a representative of the ignorant crowd I have a notion (founded not on knowledge, for the higher mathematics are beyond me, but on hearsay) that mathematicians have reached their conclusions by taking space of more than three dimensions into account I cannot perceive such space, and therefore cannot imagine it, and I am sure that no mathematician is better able We can imagine only in terms of the senses which we have already used Because I have seen, I am able to picture a dragon such as was never yet on land or sea But a congenitally deaf man has no conception of sound, and one who was born blind thought that scarlet was like the sound of a trumpet Since our senses do not reveal more dimensions than three, we can gather no clearer conception of four or more than the congenitally blind or deaf have of sight or sound Nevertheless, on production of evidence, we may believe in these inconceivable dimensions just as the blind or deaf believe in sight or sound

Doubtless many aspects of reality are outside the range of our senses If I am right as to what mathematicians have been at, all this seems simple If, by taking more than three dimensions into account they have been able to predict truths hitherto unknown to us then we must accept their evidence, and believe, for example, that lines that seem straight or parallel to us are not really so But the work of mathematicians is one thing, the work of those who expound it to the ignorant is another thing For example, it is one thing to say that the straight or parallel lines of our perceptions are not really straight or parallel, but quite another thing to declare that space itself is curved, and therefore that straight lines curve and parallel lines meet In other words, it is one thing to say that our senses are defective, and another thing to announce that contradictory statements are both true

G ARCHDALL REID

20 Lennox Road South,
Southsea, Jan 11

ON page 84 of NATURE for Jan 19, Mr McLennan expresses polite surprise that I allow myself to accept results, even on good evidence, which are repugnant to uninstructed common sense, or in other words, which run counter to the prejudices born of lifelong experience Unfortunately, it has been my lot to come across phenomena so superficially alien to common sense that they are not acceptable to the scientific world, though they nevertheless presumptuously occur Apart from those untoward happenings, however, and on more ordinary lines, we have to admit that common sense is not always a trustworthy guide in the face of evidence to the contrary Even 1 and 1 are not always 2 when the units are concrete things, especially when the element of time is allowed to function If they are mercury globules, in a little while the result may be still 1, whereas if they are amœbæ the result may be 4 Simple addition is not always the correct rule for compounding quantities, any more than the rule of three need be valid when simple proportion is not guaranteed

The compounding of two velocities certainly looks as if it should be done by simple addition, but we must remember that the speed of a body moving on the earth is not an absolute or complete specification Something has been ignored Both bodies are moving through space and space (or ether) has an unknown constitution It is certainly afflicted with something which poses as a constitutional velocity,—a constant which declines to be ignored in extreme cases, and which we call c So our ordinary velocity v may more strictly or fully be specified as v/c, for it is a fraction of the fundamental velocity in space Hence when compounding u/c with v/c, to get the result w/c, simple addition turns out to be insufficient, the product uv/c^2 is involved as well Many a schoolboy has found, to his chagrin, that $\tan(a+b)$ must not be written down as $\tan a + \tan b$, but that the product $\tan a \tan b$ is involved as well That velocities ought to be compounded in this semi trigonometrical fashion is not the least obvious, but that the fact is so may be intensely important, for it suggests that in space there is something rotational, which makes no appeal to the senses and can be ignored by engineers and practical people, though it may not be ignored by physicists

To take another example The velocity of light in stagnant water is c/μ, and if the water is flowing in the same direction with velocity v, common sense might say that the resultant velocity of the light should be $c/\mu + v$, but that is not what Fizeau found to be true He found experimentally, what Fresnel had previously predicted, that v/μ^2 must be subtracted from the sum in order to give the true result

All these queer rules of composition follow from the Larmor Lorentz transformation, which was invented some years before relativity was heard of, though it was Einstein who seized the idea, boldly reclaimed it from abstraction, and applied it to actuality, in spite of the strangeness and apparent absurdity of some of the results Would that science generally might gradually perceive that occurrences apparently preposterous may nevertheless be true! The universe is regulated by sense, no doubt, but not by common sense or uninstructed prejudice

In conclusion, I quite sympathise with Mr McLennan, and indeed with the others, in their temporary bewilderment Odd results ought not to be accepted too cheaply

OLIVER LODGE

Normanton House,
Lake, Salisbury, Jan 20

MR MCLENNAN says (NATURE, Jan 19, p 83) that $V + v = V$ is incompatible with common sense Is $P + \rho = P$ equally incompatible, where ρ is density and is he forced to believe that the density of a mixture must always be greater than that of either of its components? Doubtless he will say, No If he will consider very carefully why he thinks velocity, but not density, must be additive, he will probably arrive at a solution of his other difficulties

N R C

An Iodine Liberator from Laminariæ

AN aqueous extract of fresh fronds of Laminariæ will, when acidulated, liberate iodine from potassium iodide

This fact, recently observed by me, does not seem to have been previously recorded It suggests an explanation of the process by which marine algæ

collect comparatively large quantities of iodine from the sea water in which it occurs in such low concentrations It seems possible that at certain parts of the plants or at certain times of the year a sufficient acidity is developed to enable this iodine liberating body to act on the inorganic iodides in the sea water which is in contact with the fronds The iodine thus liberated would then combine with unsaturated bodies in the plants According to this theory, the inorganic iodides which are found in the plants would of course be secondary products of metabolism The existence in various varieties of algæ of unsaturated acids which would serve for the absorption of the free iodine has recently been demonstrated by Tsujimoto (*Chem Umschau*, **32**, 125, 1925)

The presence of an iodine liberator would also furnish an explanation of the observations of Freundler, Menager, and Laurent (*Compt rend*, **173**, 1116 1923) on the loss of iodine by seaweeds on drying During the drying, acidity probably increases to the point at which the iodine liberator can act

The iodine liberating solution is easy to obtain In my experiments the fronds of *Laminaria digitata* or *Laminaria saccharina*, freshly gathered from the seashore, where they had been thrown up by the tide, were minced in an ordinary mincing machine, treated with their own weight of distilled water containing a little toluene (5 c c per litre) to arrest bacterial action, and left standing for about twenty four hours The liquid was poured off through a Buchner funnel (without filter paper), and this liquid, on treatment with a little hydrochloric or acetic acid and a solution of potassium iodide, gave a pink colour on shaking up with carbon disulphide The pink colour may sometimes be observed without the addition of potassium iodide, sufficient iodides being already present in the solution The addition of potassium iodide, however, seems to intensify the colour

When the solution was placed in a parchment filter which was immersed in distilled water for a few days, the iodine liberating property was found in the outer liquid In fact, this dialysed product appeared to be more active than the original extract

Boiling does not appreciably impair the iodine liberating power of the solution This fact, together with its property of dialysing through parchment, pointed to the possibility that the active agency consisted of ferric ions The solution does not give a pink colour with potassium thiocyanate, but I have found that concentrations of ferric chloride which give a doubtful response to this test will when acidulated liberate easily detectable quantities of iodine When 25 c c of the solution were evaporated to dryness and ignited and the resulting ash dissolved in 2 c c of dilute hydrochloric acid, this solution gave a pink colour with potassium thiocyanate Iron is therefore present, but only in such concentration that if it exists as ferric ions, the liberation of iodine by it would be very slow

Any theory that inorganic ions are responsible for the iodine liberating activity of the liquid seems, however, to be ruled out by the following experiment 25 c c of the dialysed product were evaporated to dryness in a beaker on a piece of wire gauze, and carefully heated until the yellow residue began to turn brown This residue was then dissolved in dilute hydrochloric acid and the solution was made up to about 24 c c (a little less than the original volume) The solution thus obtained did not liberate iodine

From the observations so far made, the iodine liberating agent would appear to be a dialysable organic body Further study of the substance is in progress In the meantime it should be of interest to try whether such a body can be detected in the thyroid gland In this connexion I should mention that while I have never had any difficulty in obtaining an iodine liberating extract from Laminariæ, in my only experiment with *Fucus* (which contains a much smaller percentage of iodine) I failed to obtain it If an iodine liberator exists in the thyroid gland, its detection will be by no means so easy as in the case of Laminariæ

Thomas Dillon
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Dissociation of Hydrogen by Collisions of the Second Kind

Heitler and London have calculated the potential energy of the ground state of H_2, and they have found besides the known 1^1S state, another potential energy curve which is called by them 1^3S This curve is higher than the 1^1S curve by an amount equal to the heat of dissociation of the hydrogen molecule Stuckelberg and Winans have used this curve to explain in a very nice manner the continuous spectrum of the hydrogen molecule Their explanation, in brief, is that transitions from any one of the excited triplet levels to this 1^3S level give rise to a continuous spectrum

It is the purpose of this short note to direct attention to the application of this new level to the interpretation of the Cario and Franck experiment on the dissociation of molecular hydrogen in a mixture of hydrogen and excited mercury atoms in the 2^3P_1 state The usually accepted interpretation is that the energy of excitation of the mercury atom goes into an increase in the vibrational energy of the hydrogen molecule, and since the energy of the mercury in the 2^3P_1 state is more than sufficient to dissociate the molecule, enough energy of vibration is acquired during the collision to dissociate it Other explanations have been suggested, such as the possibility of a chemical combination taking place between the excited mercury atom and the hydrogen molecule and subsequent dissociation ensuing It is possible now to propose still another interpretation for the Cario and Franck experiment The explanation is, briefly, that the result of a collision between an excited mercury atom and a normal hydrogen molecule is the excitation of the molecule from the 1^1S to the new 1^3S level Since the potential energy curve in this level possesses no minimum, it is an unstable state and immediate dissociation results

The question arises as to the probability of such a transition occurring Since 11 5 volts is very close to the height of the 1^3S curve over the 1^1S curve at the nuclear separation corresponding to the minimum of the 1^1S curve, it is quite clear that for electron impact the most probable transition is one corresponding to nearly this energy This is simply in accordance with the Condon theory of band intensities, and in terms of the potential energy diagrams for the two levels it means that the most probable transition is a vertical one Elsewhere, Dr Kinsey and I have directed attention to evidence which points to the fact that in collisions of the second kind between excited entities and diatomic molecules, diagonal transitions are very probable (*Physical Review*, Abstract in press) We have here, therefore, another phenomenon that provides evidence for the truth of the above statement that it is possible to cause diagonal transitions in collisions of the second kind, whereas in electron impact the most probable transitions are vertical ones

This interpretation of the Cario and Franck experiment requires that dissociation of hydrogen should occur by collisions of the second kind with atoms or

molecules that possess energy greater than the energy of dissociation It does not follow any longer that dissociation will be most probable when the energy of the excited entity is most nearly equal to the dissociation energy The most probable conditions for dissociation will now be determined by the most probable jump between the two potential energy curves for the 1^1S and 1^3S levels

This explanation of the Cario and Franck experiments does not, without further discussion, rule out the explanation that the energy goes directly into vibrational energy in the normal 1^1S level This question of the transfer of energy from electronic to vibrational energy will be considered in a future communication

JOSEPH KAPLAN

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Microseisms associated with Storms in the Indian Seas

THE ground is never at rest, and a seismograph provided with an aperiodic pendulum and a large magnification will always record these ever present movements The types are often so complicated that it is not easy to distinguish those associated with definite weather disturbances To obviate these difficulties, a Milne Shaw seismograph was installed some four years ago in the underground constant temperature room of the Colaba Observatory and its working condition was so arranged that it should just cease to record microseisms when the weather was undisturbed over the neighbouring seas, as in the months of January and February, when the wind velocity seldom exceeds 20 miles per hour over the sea areas It was then noticed that microseisms made their appearance in the records whenever weather was disturbed over the Arabian Sea or the Bay of Bengal, so as to cause rough seas over a fairly wide area In particular, three distinct types of microseisms were recognised, and these were associated with (1) the south west monsoon, (2) the storms in the Arabian Sea and the Bay of Bengal, and (3) local disturbances, such as pronounced land and sea breezes Those associated with the south west monsoon are steady vibrations, having periods varying from 4 to 10 seconds, according to the strength of the air current over the sea

The periods and the amplitudes of these movements are easily explained theoretically if they are considered to be standing vibrations on the earth's surface, combining to form progressive waves, analogous to Rayleigh waves, produced and maintained by the sea waves generated by the monsoon currents The microseisms associated with storms have periods varying from 4 to 6 seconds and show typical irregular variations in amplitude owing to superpositions of waves of different periods arising on account of the existence of a marked difference in wind velocity in the storm and surrounding areas They make their appearance in the seismograms as soon as a storm has formed, and disappear only after it has passed inland and ceased to affect the sea.

The types are readily distinguished, and thus throw open to the meteorologists a new method of forecasting the existence of storms The amplitudes of microseisms are found to be a function of the distance and the intensity of the storms For example, the microseisms developed by the storm in the Arabian Sea, which crossed the coast between Bombay and Ratnagiri on Nov 12, 1927, had amplitudes about four times larger than those due to a storm in the Bay of Bengal, which crossed the coast near Nellore ten days before, but the types were identical

During the pre monsoon and the post monsoon periods, when the records are almost free from monsoon microseisms, the formation and the early development of a storm are easily recognised by the gradual appearance of feeble microseisms of variable amplitude, which become more and more marked as the storm is fully developed During the four years the instrument has been in operation, several storms formed in the Arabian Sea and the Bay of Bengal and all of them gave rise to microseisms of this kind from the time of their formation until they passed inland and ceased to disturb the sea

The microseisms associated with a local disturbance have large periods, varying from 20 to 30 seconds, and appear to be caused by waves over the shallow sea near the coast, for such waves have periods of exactly this order They are certainly not due to the shaking of buildings and trees by gusts of wind, for such shakings will cause vibrations, which in an ordinary building will have periods less than 0 1 sec A detailed account of these investigations is now ready and will be shortly published

S K BANERJI

The Observatory, Bombay,
Nov 30

Refraction of Beams of Molecules

IN the Stern Gerlach experiment the deviation of a beam of molecules in a magnetic (or electric) field is comparable to the optical case of the refraction suffered by a beam of light in traversing a medium, the refractive index of which varies in a direction perpendicular to the beam, the variation of the refractive index being analogous to the force or gradient of the field However, in optical instruments the standard method of obtaining refraction is to allow the beam to travel from a homogeneous medium of refractive index n_1 to another of refractive index n_2 The total refraction is then independent of the rate of variation of refractive index in the interface

It is of interest to follow out the obvious analogy for a molecular beam In the diagram, a beam of

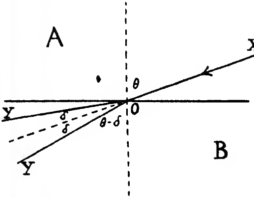

FIG 1

molecules XO passes from a region of no magnetic field A to another region B in which obtains a homogeneous magnetic field H perpendicular to the plane of the paper Such a field can be produced between the flat pole pieces of a magnet Let the beam be in the plane of symmetry between the pole pieces We consider for simplicity a beam of alkali atoms in the normal state with kinetic energy E The atoms will be orientated parallel or anti parallel to H

Since there is no component of the force parallel to the edge of the pole piece, we have as in the optical case,

$$\sin(\theta - \delta)v_B = \sin\theta v_A,$$

$$\frac{\sin\theta\cos\delta - \cos\theta\sin\delta}{\sin\theta} = \frac{v_A}{v_B} = \frac{\sqrt{\frac{2E}{m}}}{\sqrt{\frac{2}{m}(E+\mu H)}},$$

where μ is the Bohr magneton

Since δ is small

$$\delta = \left(1 - \frac{1}{\sqrt{1+\frac{\mu H}{E}}}\right)\tan\theta$$

If the ratio $\mu H/E$ is small

$$\delta = \frac{\mu H}{2E}\tan\theta$$

For a distance l, the total deviation will be

$$\Delta = \delta l = \frac{\mu H}{2E}\, l \tan\theta$$

What is of experimental importance in the final equations is that the deviation depends on the value of the homogeneous field only, which enables one to dodge the serious technical difficulties involved in determining the inhomogeneity of a magnetic field in a small region

As a numerical example if l be 10 cm, $H = 10^4$ gauss, $\mu = 1$ Bohr magneton, 0.92×10^{-20} gauss cm, E the average energy for 0° C, and $\theta = 80°$ (app), then Δ is approximately 0.5 mm, a conveniently measurable deflection

The above considerations also apply to the case of an electric field, here a parallel plate condenser takes the place of the flat pole pieces One can also generalise the above procedure and construct analogues of prisms, etc

A complete discussion, including an experimental investigation, will be published in the *Zeitschrift fur Physik*

I I RABI
(International Education Board Fellow)
University of Hamburg

Photochemical Union of Hydrogen and Chlorine

SHORTLY before the close of 1927 we finished some experiments, which had extended over about two and a half years, on the photochemical union of hydrogen and chlorine Circumstances have prevented publication until now, and may impose a still further delay We therefore would wish to make known certain of our results, particularly as we think they will prove of interest to other workers in the same field

Our attention was directed towards two main points—the effect of intensity and that of wave length, using monochromatic light in both cases With regard to the former, we need only say that our results are in agreement with those obtained earlier by Mrs M C Chapman and with those published after the commencement of our experiments by Kornfeld and Steiner and by Marshall The effect of wave length on quantum efficiency was, however, surprising We worked with moist electrolytic gas, employing the Bunsen Roscoe technique and used the quartz mercury lamp lines at (*circa*) 546, 436, 405, 365, 313, and 260 $\mu\mu$, separating these so far as possible by means of filters Four of the latter let through less than one per cent of foreign light, and the only serious uncertainty arose with the filter for 260 $\mu\mu$ The incident intensities, as also the amount and nature of foreign light in the beams used, were determined by thermopile measurements, and the absorbed intensities calculated from the data of von Halban and Siedentopf The result was that we found the quantum efficiency to rise from 546 $\mu\mu$ to 405 $\mu\mu$, and then, as the frequency was increased, to fall off to 260 $\mu\mu$ The actual (relative) figures are as follows

Wave length	260 $\mu\mu$	313 $\mu\mu$	365 $\mu\mu$	405 $\mu\mu$	436 $\mu\mu$	546 $\mu\mu$
Quantum efficiency	0 10	0 49	0 53	1 00	0 67	0 22

The figure for the first group of lines could only be determined very roughly, but certainly did not exceed fifty per cent of that obtained for the same gaseous mixture, with practically monochromatic 436 $\mu\mu$ radiation The sensitivity of the gas used in the various experiments corresponded to a yield of the order of 200,000 molecules of HCl per quantum of blue light absorbed It showed no induction period, but gave a marked Draper effect during the first instants of insolation

Experiments carried out at 19 7° and at 25° showed the relative temperature coefficients of the quantum efficiency to increase slowly, but unmistakably, with wave length between 313 $\mu\mu$ and 436 $\mu\mu$ Other experiments in which two 'monochromatic' beams were allowed to act simultaneously gave a velocity equal to the sum of their separate effects, in disagreement with work of Padoa, but in agreement with the conclusion to be drawn from the experiments on the effect of intensity

It is difficult to explain our main results without recourse to *ad hoc* hypotheses, of which we have considered many To two points, however, we would direct attention The relative efficiencies found for the 436 $\mu\mu$ and 260 $\mu\mu$ rays are in agreement with the experiments of Heymer (1927), whilst the definite effect of the mercury green line (most workers seem to assume, on insufficient experimental evidence, that it would be inactive) is in accord with recent work of W Taylor

Further experiments, using spectrally dispersed light, are now being started in this laboratory

A J ALLMAND
EDWARD BEESLEY

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Jan 21

Diffraction of Electrons at Ruled Gratings

IN June of last year (*Proc Phys Soc*, vol 40, p 284) I made a preliminary announcement of an experiment on the diffraction of electrons from a ruled grating in much the same way as has been done with X rays In a recent publication summarised in NATURE of Jan 5, p 29, E Rupp has published results of an investigation on this subject, using a method very similar to my own, in which he obtains diffraction images on one side of a reflected line, which yield a value of the equivalent wave length in good agreement with the de Broglie value In view of the immediate interest in experiments of this type, I give below the results of a preliminary experiment which I obtained in December last

Electrons from a coated filament were 'collimated' and sent at a glancing angle of the order of 1° on to a ruled grating (speculum) A series of experiments verified that electrons, but no light, were falling on the grating, and a photographic record was obtained which clearly showed a diffracted line on *both sides* of the direct reflected line Any doubt as to this

being due to secondary X rays from the slits, etc, was eliminated, as a simple calculation shows that 1300 volts were necessary to produce X rays corresponding to the upper limit assigned to the observed pattern, whereas the maximum accelerating voltage applied from accumulators did not exceed 85 volts

The photograph is not ideal for reproduction or precise calculation but the diffracted lines are clearly visible to the eye and show an assymmetric displacement about the direct reflected line as is anticipated from theoretical considerations These points are seen in the accompanying diagram (Fig 1) which

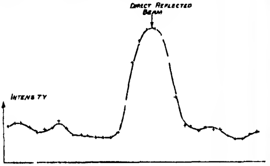

FIG 1

shows the result of a photometric examination of the plate kindly made by Dr W H J Childs

The results differ from those of Rupp inasmuch as there are diffracted images at both sides of the reflected line This is to be anticipated from general considerations of diffraction and in the X ray case Compton and his school obtain a similar effect

The ordinary optical formula for a grating when using small glancing angles θ reduces to

$$n\lambda = \frac{d\alpha}{2}(2\theta - \alpha)$$

where α is the angle between the reflected and the diffracted line and d is the grating element Clearly, when $\alpha = \theta$ a limit is reached, which shows that when θ is less than $\sqrt{2\lambda/d}$ no diffracted line will occur on the small angle side of the reflected beam Rupp uses very small angles θ and his one sided diffracted system is therefore explained on these lines

These experiments are still in progress and I hope to make an early announcement of more results, and a description of the experimental details

B L WORSNOP

Wheatstone Laboratory,
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London W C 2 Jan 19

The Refractivity of Gaseous Compounds

SOME simple relations appear to exist between the refractivities of a number of gaseous compounds and their constituents in the gaseous state which so far as I know, have not hitherto been published The refractivity of an atom depends largely on the outer electrons which are loosely bound to the nucleus Previously it has been considered that when combination occurs between atoms the outer electrons are so distorted that the refractivity of a molecule is not related in any simple way to the refractivities of the constituent atoms and that the deviation from an additive law is a measure of the distortion (cf Fajans and Joos, *Zeit f Phys*, vol 23, p 1, 1924, Born and Heisenberg, *Ibid*, vol 23 p 388, 1924, Havelock, *Phil Mag*, vol 3 pp 158, 433, 1927)

The following simple relations have been observed If $(\mu - 1)_R$ is the refractivity of the substance R, *in the gaseous state* under normal conditions as defined by Cuthbertson (*Phil Trans Roy Soc* vol 204 p 323, 1905) where μ is the refractive index then

$$(\mu - 1)_{HCl} = \tfrac{4}{7}(\mu - 1)_{Cl_2}$$
$$(\mu - 1)_{HBr} = \tfrac{13}{25}(\mu - 1)_{Br_2}$$
$$(\mu - 1)_{CCl_4} = \tfrac{16}{7}(\mu - 1)_{Cl_2} - 4(\mu - 1)_{HCl}$$
$$(\mu - 1)_{CS_2} = \tfrac{4}{3}(\mu - 1)_{S_2}$$

The ratios ($\frac{4}{7}$) ($\frac{13}{25}$) ($\frac{16}{7}$) and ($\frac{4}{3}$) are closely related to the number of loosely bound electrons which in Cl_2, HCl CCl_4 S_2 and CS_2 are assumed to be the *M* electrons and in Br_2 and HBr the *M* and *N* electrons If the chlorine atoms in HCl and CCl_4 and the bromine atom in HBr are singly ionised and if the sulphur atoms in CS_2 are doubly ionised then Cl_2 contains fourteen loosely bound electrons HCl eight CCl_4 thirty two S_2 twelve CS_2 sixteen Br_2 fifty and HBr twenty six It is seen that the ratios between the numbers of loosely bound electrons are the same as the ratios between the refractivities

This way of regarding the problem is obviously much too simple and is applicable in only a few cases In general relations of the kind given above do not appear to exist between the refractivities of substances in the gaseous state It is indeed surprising how well the simple relations hold for HCl HBr CCl_4 and CS_2 In Table 1 results are given for HCl and Cl_2 for a series of wave lengths λ

TABLE I

λ	$(\mu - 1)\times 10^6$ (1) $(\mu - 1)_{Cl_2}$	(2) $(\mu - 1)_{HCl}$	(3) $\frac{4}{7}(\mu - 1)_{Cl_2}$	Percentage Difference between (2) and (3)
6707 8	77 563	44 375	44 320	−0 1
6438 5	77 703	44 444	44 400	
5790 5	78 121	44 656	44 640	
5769 5	78 135	44 666	44 648	
5460 7	78 400	44 800	44 800	0
5209 1	78 651	44 930	44 944	
5085 8	78 791	45 007	45 024	
4799 9	79 166	45 187	45 240	+0 1

It is intended to give a more detailed account of this work soon together with some general observations on the refractivities of other gaseous compounds

G W BRINDLEY
(Darbishire Research Fellow)
University of Manchester
Dec 28

Palæolithic Pottery

IN NATURE of Jan 19 p 104, it is stated in reference to Mr Leakey's discovery in Kenya of pottery associated with an Aurignacian industry, that nowhere else does pottery occur at so remote a period

There are, however, on record certain discoveries which go to show that this statement perhaps needs modification These are—

1 The finding, in the cultural layer immediately overlying that in which the famous Neanderthal skeletons of Spy were unearthed of the bones of 'fossil animals, also those of a few living species,

several thousands worked flints, some of which still of the Mousterian type, many worked bones, including arrow points, and also fragments of pottery "[1]

2 The discovery, in several caves in Belgium, of the remains of pottery in Upper Palæolithic deposits[2]

3 The finding, by me, in a small valley to the north of Ipswich, of fragments of pottery, of a hitherto unknown type[3] associated with flint implements of Upper Mousterian or Lower Aurignacian forms, in a geological deposit of manifest antiquity In regard to this latter discovery, I may say that it was by no means easy to recognise, at first, that the fragments of what looked like charcoal in the geological deposit mentioned were indeed pieces of pottery, and it was only by a very careful examination that this recognition was made possible

Personally, so small a value do I place upon the making of primitive pottery as an indication of the advancement and capabilities of any prehistoric people, that it would not surprise me to hear of its discovery in, for example, a 'floor of Late Acheulean age

It is, of course possible, for those who do not believe that Palæolithic man made pottery, to deny that any of the discoveries I have enumerated are of Palæolithic age But this claim carries with it the necessity of proving it to be true

J REID MOIR

Ipswich

Short Wave Echoes and the Aurora Borealis

BOTH Prof Appleton and Dr van der Pol have suggested in letters in NATURE of Dec 8 that the echoes observed by Prof Størmer with delays of about ten seconds might be explained by the disturbance spending a long time in a region containing so many electrons per c c that the group velocity of the disturbance was very small

The effective dielectric constant ϵ and conductivity σ of a region containing N free electrons per c c for waves of frequency $\omega/2\pi$ are given by $\epsilon + \frac{4\pi\sigma}{i\omega} = \frac{3+2\alpha}{3-\alpha}$, where $\alpha = -\frac{4\pi N e^2}{m(\omega^2 - if\omega)}$, f measures the rate at which the velocity of the electron becomes uncorrelated with its initial velocity, so that $f = v/l$ where v and l are the velocity and effective free path of the electron The condition that the group velocity is zero is that $\epsilon = 0$, i e, since $f \ll \omega$, $N = 3m\omega^2/8\pi e^2 = 1\ 9 \times 10^6$ electrons per c c for wave length 30 metres (Dr van der Pol, *loc cit*, using the formula valid for small α, obtains $N = 10^6$)

Even if the atmospheric pressure is very low, so that collisions with atoms contribute little to f, a minimum value of f, for given N, is fixed by the effects of the electrostatic forces between the electrons, and between the electrons and other ions A calculation I have recently made (*Proc Roy Soc*, A, vol 121, p 464) gives the following approximate formula for the effective mean free path in such circumstances,

$$l = 3v^4 \Big/ 4\pi\left(\frac{2e^2}{m}\right)^2 N \log\left(3v^4/4\pi\left(\frac{2e^2}{m}\right)^2 N\right)$$

Assuming $v = 1\ 2 \times 10^7$ (P O Pedersen, "The Propagation of Radio Waves," p 44) we obtain $l = 4\ 8 \times 10^2$ cm, $f = 2\ 5 \times 10^4$

For a delay of t seconds the signal intensity is reduced to $e^{-ft/2}$ of its initial value (Prof Appleton, *loc cit*), that is, for a delay of 10 sec to $e^{-125\,000}$ The suggested explanation seems, therefore, to be untenable, unless it is assumed that v is much larger If v were 30 times as large ($v = 3\ 6 \times 10^8$, corresponding to 37 volts) the minimum reduction for a 10 sec delay would be to $e^{-4\ 6}$ ($= 1/100$) of its initial value

The above objection does not apply to the second explanation put forward by Prof Appleton

L H THOMAS

Trinity College,
Cambridge, Jan 14

[1] Hrdlicka, *Annual Report of the Smithsonian Institution*, 1913, p. 522.

[2] *Bull. Soc préhist. de France* 1907–8 (two papers)

[3] "Antiquity of Man in East Anglia. Camb Univ Press, p. 87, Fig. 35

Oiling of Plates for Ultra-violet Photography

IT has long been known that a substitute for the Schumann plate for ultra violet spectroscopy beyond 2500 A can be made by oiling the surface of the plate These oiled plates were found by Harrison (*Jour Optical Soc Amer*, vol 11, pp 113 and 341, 1925) to be in some respects superior for photometry, as Schumann plates are rather uneven, having spots of greater sensitivity All the methods so far suggested for oiling the plates are rather messy and involve the cleaning of the plate before development There is also a loss of sharpness due apparently to the thickness of the oil coating The following method used

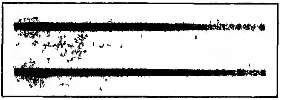

FIG 1

by me seems to overcome these disadvantages and may be of interest to other workers in the subject I use a filtered solution of 5 grains of vaseline in a litre of petroleum ether The quantity of vaseline may be increased for certain work The plates are flooded with this solution in a dish and lifted out and rapidly dried After exposure they can be developed without further treatment by the 'stand method'

The accompanying photograph (Fig 1) is of the aluminium condensed spark from the visible to 1830 A The exposure was 15 sec in each case on a Wellington anti screen plate The first exposure was made, the plate was then flooded with the 0 5 per cent solution three times, being dried between each The second exposure was then made and the plate developed in glycin

A CHRISTOPHER G BEACH

Chelsea Polytechnic,
London, S W, Jan 7

Raman Lines from Hydrochloric Acid Gas

(BY CABLE, THROUGH SCIENCE SERVICE, WASHINGTON, D C)

BY employing a long end-on tube excited by a parallel Cooper Hewitt mercury arc with aluminum reflectors, I have obtained the modified lines of gaseous hydrochloric acid at atmospheric pressure corresponding to the vibration-rotation absorption band at 3 6 μ, a double line with indications of fine structure Improved technique is expected to permit higher dispersion

R W WOOD

Jan 28

The Mechanism of the Nerves[1]

By Prof E D ADRIAN F R S

THE nervous system is a mass of living cells which has the extraordinary property of appearing to influence and be influenced by the mind It is a material system somehow responsible for such non material things as emotions and thoughts These are in a category outside the range of mechanical explanation and for this reason the working of the nervous system will never be fully explainable in terms of physics and chemistry But some of the processes which take place in it can be treated in this way and there will be no need to alter our methods of approach until we have gone a great deal further by the recognised routes These routes are many and the present article deals with only one of them It deals with the analysis of the messages which travel along the nerve fibres—an analysis made possible by the recent development of the triode valve amplifier

The active elements of the nervous system consist entirely of cells giving off fine thread like extensions of protoplasm These make up complex interlacing fibres forming the grey matter of the central nervous system but most nerve cells give off one thread much larger than the rest (the axon) and this forms the channel of communication between the cell and the more distant regions It may lead to other parts of the central nervous system or it may pass outside and lead to a sense organ or to a group of muscle fibres or secreting cells At a short distance from the cell the axon develops a fatty sheath and outside the central nervous system it is protected by an external covering of tubular cells the neurilemma The whole forms a nerve fibre with a diameter ranging from 2 to 20 microns and a length which (in man) may exceed one metre The peripheral nerves are made up of bundles of these fibres having a common area of distribution the number of fibres in a nerve trunk often running into several thousand The communicating tracts of the central nervous system are similarly constituted

We have known for some time that a nerve fibre can conduct a particular type of message under artificial conditions A special branch of physiology has been occupied for a hundred years in investigating the changes which take place in a frog s nerve and muscle isolated from the body and stimulated mechanically or electrically If the nerve is pinched or if a current is passed through a short length of it the muscle contracts Some disturbance has passed down from the stimulated region of the nerve and this is able to make the muscle develop its normal activity In a frog s nerve the disturbance or nervous impulse travels at the rate of 20 30 metres a second No visible change accompanies it The thermal changes are so small that it is only in the last few years that A V Hill has been able to detect them and the chemical changes can only be studied by repeating the stimulation over long periods so as to obtain a measurable result

One accompaniment of the impulse is more readily detected however and this is the electric response or action current Whenever the impulse arrives in a particular section of the nerve a change of potential is developed between the active and the neighbouring inactive parts and a current flows through the fluid surrounding the nerve or through a galvanometer connected to the active and inactive regions As the active region travels down the fibre the current flows shift with it and this electric charge accompanies the impulse whatever form of stimulus is applied to the nerve The electric charge is small enough —when every fibre in the nerve is in action simultaneously the potential change is of the order of 10 millivolts and the whole thing is over in a few thousands of a second But it can be detected by instruments like the string galvanometer or the capillary electrometer which combine sensitiveness and high periodicity and it has given us a great deal of our information about the nature of the impulse

Briefly we find the impulse to be a momentary disturbance the intensity of which at any point is determined entirely by the condition of the fibre at that point Stimulating the nerve may be compared to firing a gun we may pull too feebly on the trigger but if we pull hard enough to fire the bullet no amount of extra pulling will make it travel any faster In the same way we cannot regulate the intensity or rate of travel of the impulse by regulating the stimulus Again the gun needs reloading before it can be fired again and in a nerve fibre the passage of an impulse is followed by a very brief interval during which a further stimulus is ineffective Each impulse is a discrete change with definite time relations and there can be no continuous activity in the fibre but only a succession of impulses

The impulse takes place in a highly complex system and no doubt it involves a whole succession of reactions which will take many more years to unravel But it seems fairly clear that one of the principal events is the passage down the fibre of a wave of surface change which allows an interchange of ions to take place between the interior and the exterior in the active region and so to give rise to the action current Rapidly spreading surface changes are known in many inorganic systems and R S Lillie has developed a model which presents an extraordinary close analogy with the nerve fibre When an iron wire is immersed in strong nitric acid its surface becomes coated with a layer of passive iron (probably an oxide) which prevents the acid from acting any further If the film of passive iron is destroyed at any point the difference of potential between the active and passive iron produces a current which has the effect of destroying the passive film

[1] Substance of two lectures delivered at the Royal Institution on Nov 22 and 29

in the neighbouring section of the wire and at the same time restores it where it was first destroyed Thus the area of surface change spreads down the wire accompanied by an electric change which is a close copy of the action current in a nerve Moreover the iron wire model like the nerve can be stimulated by electrical as well as mechanical means

We are still very far from knowing all that goes on when an impulse passes down a nerve fibre but at least it has none of the variability we might expect and we seem to be dealing with a definite series of changes following one another with mechanical regularity changes which can be made to repeat again and again yielding similar measurements whenever we have instruments sensitive enough to record them

Unfortunately the changes are so small that even the electric response can only be recorded directly when all the fibres in a nerve trunk are acting simultaneously In the body they act more or less independently and until recently we could not even be certain that the disturbances transmitted from sense organs or nerve cells might not differ considerably from those studied in the isolated muscle and nerve preparation But the whole position has been altered by the advent of the triode valve amplifier It is now possible to magnify the smallest and briefest electric changes until they are large enough to affect a recording instrument chosen not for its sensitiveness but for its ability to give a true rendering of the most rapid fluctuations of current The delicate string galvanometer may be replaced by the insensitive capillary electrometer by the moving iron oscillograph recently developed by Matthews or even by the cathode ray oscillograph used for physiological work by Erlanger and Gasser In fact if electric changes do occur in the normal working of the nervous system we can no longer complain that they are too small to measure

With the aid of valve amplification it is very easy to show that the messages which pass into or out of the central nervous system are accompanied by rapid fluctuations of potential in the nerve trunk This and indeed almost all the features of the nervous messages can be demonstrated to a large audience by converting the amplified potential changes into sound waves with a loud speaker A small piece of skin from the frog with the attached cutaneous nerve is set up in a stand with electrodes leading from the nerve to the amplifier input and whenever the skin is touched the nervous message set up by the sense organs in the skin becomes audible as a crackling sound in the loud speaker

This by itself tells us very little about the nature of the message in each nerve fibre for we are recording the confused effect of a number of fibres acting independently To restrict the activity to one fibre we have either to divide all but one of the active nerve fibres (a difficult but not an impossible undertaking) or to arrange that the stimulus shall affect only one end organ The former method has been used for studying the messages sent by the motor nerve cells to the muscles and the latter for the messages from sense organs The results then become very clear and very simple To deal first with the sensory message we find that it consists of a series of impulses quite indistinguishable from those produced by artificial stimulation These recur fairly regularly at a frequency which varies between 5 and 150 a second All the impulses are alike but the frequency with which they recur depends on the intensity of the stimulus to the sense organ This is true of all the sense organs which have been investigated although there are characteristic differences in the behaviour of different kinds of sense organ under a continued stimulus

The changes in frequency will be enough to signal the intensity of the stimulus but what is there to indicate its quality ? There are two possible answers to this One is that all the messages arising from a touch corpuscle produce sensations which we recognise as touch because they are conveyed by a particular nerve fibre and led through particular channels in the central nervous system The other is that the impulses from different sense organs are in fact not exactly alike The sensory nerve fibres differ considerably in diameter Erlanger and Gasser have shown that the duration and rate of travel of the impulse varies with the diameter of the fibre and Matthews has added the fact that sensory impulses produced by tension on a muscle travel faster than those produced by touching the skin Whether there is a distinct size of fibre corresponding to every quality of sensation is uncertain and it is equally uncertain whether the impulse will preserve a characteristic form as it travels through the terminal branches of the fibre but in the nerve trunk at least the physiologist can tell from its form whether an impulse arises from skin or muscle and the central nervous system may perhaps differentiate in the same way

The investigation of the sensory message can be used to study the mode of action of the sense organs and it can give precise information about the distribution and course of the sensory fibres for example in the viscera A great deal remains to be done on these lines but we must pass on to messages of a different origin

The messages which pass from the motor nerve cells to the muscles are equally simple They consist of impulses of the same kind spaced not quite so regularly but covering very much the same range of frequency as the sensory impulses The impulses which produce a feeble reflex or voluntary contraction recur at frequencies as low as 8 15 a second With more intense excitation the nerve cells discharge at frequencies as high as 60 100 a second and so produce a contraction of greater force This agreement in the range of impulse frequency produced by the motor nerve cells and the various types of sense organ is the more striking when we remember the widely different structures involved

Since all these messages are so much alike we might reasonably expect to find that all the messages which pass to and fro in the tracts of the central nervous system are of the same type For one case at least this can be verified The optic nerve

though it passes outside the central nervous system, is really a central tract connecting it with the retina, which is an elaborate nervous outgrowth from the brain The messages which pass down the optic nerve when the eye is exposed to light are therefore one example of the type we might expect to find within the central nervous system They are more difficult to analyse than those in the peripheral nerves, but there is little doubt that they consist of impulses discharged in fairly regular succession at a frequency which varies with the intensity of excitation of the ganglion cells of the retina and varies over much the same range as before To generalise on one case may bring a speedy retribution, but it is hard to resist the conclusion that all the messages in the nerve fibres are of one type, with impulses spaced more or less evenly at frequencies which vary according to the urgency of the message

Much remains to be done before we can be certain of this, and if the generalisation is correct we shall still be very far from knowing how the messages are generated and what determines the pathways through which they travel The great controlling and co ordinating stations of the central nervous system may work on lines far too complex to be analysed by methods available at the moment, but at least we can say that they receive their information and issue their orders in an extremely simple manner

Forestry Research Work in France

IN the *Annales de l'École Nationale des Eaux et Forêts et de la Station de recherches et expériences forestières* (Tom 2, Fasc 1, 1928), M H Perrin, of the Nancy Forest School, publishes an account of the past and present position of research work under the title of "Les recherches forestières en France" It is admitted in France that, in spite of the fact that Colbert initiated the first commencement of correct forest conservation so long ago as 1660, the necessity or utility of research work into forestry problems was not only neglected, but also its value was called in question by the executive and practical forest officers who managed the forests Research, they considered, was pure theory, and had perhaps its correct place in the laboratory, but that its results could have any practical value out in the forests was regarded as chimerical

In the light of the present day acceptance of the unquestioned value and necessity of research work into forestry problems, the history of the question in France is not without interest For two centuries its few advocates remained in the wilderness A few obtained a partial hearing during their lifetime, but little advance was made in the practical routine methods, based on acquired practice, in force in the forests Amongst these early enthusiasts were such men as Réaumur (1683–1757), Buffon (1707–1781), Duhamel du Monceau (1700–1782), and Varenne de Fenille (1700–1793), who put forward tentatively new methods of management which were regarded as interesting but unpractical The next proposals, based on German forms of management and German doctrines, were introduced into France by four men, Baudrillart (1774–1832), Lorentz (1775–1865), Parade (1802–1865), and de Buffévent (1787–1860) The German ideas were considered too theoretical to be of any use in French forestry, which, so the experts maintained, depended not on experiments and research, but on the practical observations and experience of the men in charge of the forests

The first weakening in this attitude was due to the work of two forest officers, the first products from the Nancy Forest School which was founded in 1825 to train the officers of the Government Forest Service on scientific lines Between 1840 and 1850, these two men, Dessales de la Gibertie and E Chevandier de Valdrôme, enunciated the theory that research work was essential if better and more abundant timber and other produce was to be obtained from the forests, and that a formal plan of forest research should be laid down The ultra conservatism of the French forest regime was hard to break down, and the government showed no sign of having been converted In 1861, A Gurnaud resigned the French Forest Service in order to conduct a vigorous campaign in favour of a system of management which has since come to bear his name, and is used in the management of areas of forest in the Jura and in Switzerland

Gurnaud's 'method of control,' as it was termed, was the subject of heated discussion over long years, but it may be regarded as having aroused the attention of French forest officers, and led them to consider whether their unquestioned acceptance of routine methods, long in force, was in the best interests of the forests In 1873 a government circular was issued ordering the institution of sample plots of half a hectare in extent in the younger age classes in all State forests managed under the shelter wood compartment system—a system in wide usage in France These plots were to be measured periodically Unfortunately, no uniformity was prescribed as to the methods to be used in making the thinnings and calculating the resultant produce Consequently, the value of the results attained was not uniform, and was of little use for general comparison purposes It was a first step, however, in the recognition by government that research work might prove of value

The next step in advance was the inauguration in 1882 of the Research Station at Nancy as an annexe of the Forest School, those responsible for the new departure rightly considering that instructional and research work should go hand in hand In order to give effect to this idea, a certain number of forests adjacent to Nancy were placed under the management of the school and research centre The Forest Nursery at Bellefontaine, a few kilometres from Nancy, was also made over to the school, and as time went on other forest areas were included in the school forests, as they are termed The research officers were also permitted to make use of other neighbouring State forests for

research work A gazetted assistant forest officer was attached to the Research Station, the professors of the school, mostly drawn from the Forest Service, being chiefly responsible for the research work

In 1887 a committee was formed consisting of the director of the school, the professors responsible for research work, and the assistant forest officer The committee drew up the programme of research work to be undertaken This was a notable departure, but progress suffered from a want of funds, and to some extent from the lack of enthusiasm of the executive forest officers, by no means yet convinced as to the value of research work It was admitted, however, that there were many problems to settle in connexion with the existing management, sylvicultural, technical, botanical, meteorological, and so forth There were one or two breaks in the continuity of the work, but by 1914 the lines of research work had been more or less established under Bartet, Claudot, Jolyet, de Bouville, Guinier, and, lastly, Cuif The latter had directed attention to the numerous problems awaiting solution, and the impossibility of carrying out useful work in the absence of adequate funds

The War brought operations to an end, but in 1919, Cuif's representations were not lost sight of, and with the reopening of the station the government reorganised the management The director of the school was placed in immediate charge, with a committee comprising the professors of the school and the conservator of forests stationed at Nancy Research work was organised into four sections (1) Sylviculture and forest economy, (2) botanical, including the physical and mechanical properties of timber, (3) zoology (entomology and pisciculture—the Forest Department is in charge of fishing in the rivers and its improvement by the rearing of young salmon and trout, etc) and geology, comprising the study of forest soils, (4) work in connexion with the afforestation of denuded mountain slopes, erosion, and arrestation of dangerous torrents, and so forth Assistants were attached to the professors in charge of these sections, and annual programmes were laid down by the committee

The work of the research station concerns itself with the whole of France, but valuable help is now received by a network of what may be termed sub research centres throughout the country, the investigations carried on at these sub stations being entrusted to selected executive officers, who under take special investigations in addition to their ordinary duties Now that the value of research work has come to be fully appreciated by the executive officer, the central station has had no difficulty in inaugurating the local centres throughout the country On this question Perrin writes " Cette organisation d'annexes, nécessaire dans un grand pays où les conditions forestières varient à l'infini, paraît devoir rendre les plus précieux services elle décharge la Station de Nancy d'une besogne matérielle considérable, tout en faisant rentrer les travaux des annexes dans un cadre commun qui permettra ultérieurement de les rapprocher, et, en même temps, elle assure aux praticiens qui veulent étudier de plus près certaines questions les directives et les subsides nécessaires "

The work of the last few years bears witness to the fact that in France, as elsewhere, the War, with its enormous demands on the forest, has impressed upon the government the recognition of the fact that forestry research work is essential if those forests are to be made to yield the maximum amount of produce the varying locality factors permit

Obituary

Prof M J M Hill, F R S

By the death of Prof M J M Hill, on Jan 11, University College, London, loses one of the personalities that played a dominating part during the critical years which saw the rise of the new teaching University, and the University itself one of the most distinguished of its past *alumni* and teachers

Micaiah John Muller Hill was the eldest son of the Rev Samuel John Hill, and was born at Berhampore, Bengal, on Feb 22, 1856, during the stormy days of the Indian Mutiny He was educated at the school for the Sons of Missionaries, Blackheath, and entered University College as a student in October 1872 After a brilliant academic career in London he went up to Peterhouse, Cambridge, and in 1879 became Fourth Wrangler and Smith's Prizeman

When only twenty four years of age Hill was elected to the chair of mathematics at Mason College, as it then was,—now the University of Birmingham In 1883 he became a fellow of Peterhouse, and in 1884 he was called to the chair of mathematics at University College, London, a post which he occupied until his retirement in 1924 He was elected a fellow of the Royal Society in 1894, and was an Sc D of Cambridge and hon LL D of St Andrews

Hill's contributions to mathematics amount to nearly fifty papers, ranging over a wide field In his earlier days he was much occupied with hydrodynamical problems, and his spherical vortex' has remained a classic The duties of his chair, however, and his own peculiar bent, which prized in mathematics logic and rigour above all things, turned him eventually from applied mathematics, to which, to that subject's loss, he never returned

Hill made up for this by increased activity in the domain of pure mathematics To differential equations, in particular to the theory of singular solutions, he came back persistently, his last paper of this class dates from 1921 Another important group of researches deals with the theory of analytic continuation

The subject to which Hill devoted himself specially during the last thirty years of his life, following in this his great predecessor, De Morgan, of whom

he was a fervent admirer, was the elucidation of Euclid's famous theory of proportion, which he can be said largely to have reconstructed He was working at this almost to the very day of his death, struggling with amazing courage and success against the almost insuperable handicap of total blindness which overtook him suddenly about fifteen months ago His work in this difficult and neglected branch of the foundations of mathematics must remain of fundamental importance for all future investigators

As a teacher Hill had few equals what impressed all who came in contact with him, apart from his clarity of exposition and extraordinary mastery of detail, was the moral atmosphere that radiated from him and left its mark on all those who approached him, even those who could not follow him into the realms of abstract thought He gave, indeed, a splendid example of how a real man's work should be done, sparing no pains that the result, however slight, should be perfect, neglecting nothing, facing boldly all difficulties, a rare ideal of intellectual uprightness and moral courage

This same ideal Hill carried into his everyday life and into the very arduous tasks which he undertook in connexion with the government of the University, a burden which he bore without a murmur, though his friends, well knowing that this meant, too often, the postponement or abandonment of research work of priceless value, sometimes deplored this as a tragedy

Hill was a member of the Senate of the University from the date of its reconstitution in 1900 until 1926, when failing health compelled his retirement For ten years he was chairman of the Academic Council, and for two years (1909–1911) vice chancellor of the University To his initiative were due many important developments, the full effects of which are only now beginning to be felt, in particular, the establishment of proper machinery for appointments to chairs and readerships and many improvements in the status and qualifications of teachers of the University

Behind an outward appearance of almost difficult reserve Hill kept a heart full of sympathy and helpfulness and a fund of quiet and serene humour Both his students and his colleagues looked to him when in trouble or difficulty, nor were they ever disappointed It was characteristic of him that when, on his retirement, his friends asked him in what way he would wish them to commemorate his long connexion with the College, he remembered the financial struggle of his early years and asked that they should found a loan fund by means of which the difficulties of students in straitened circumstances might be temporarily relieved, while their spirit of independence was to be preserved by an undertaking of eventual repayment, so soon as they felt able to do so There could, indeed, have been no more fitting memorial

Prof Hill married in 1892, Minnie Grace, daughter of Marriott Ogle Tarbotton, of Nottingham Mrs Hill died in 1920 He leaves two sons, both of whom earned distinction in the field in the flying service during the War, and one daughter

PROF J M COULTER

BY the death of Prof John Merle Coulter on Dec 23, after a few weeks' illness, American botany loses one of its most eminent exponents

Prof Coulter was born at Ningpo, China, on Nov 20, 1851 After graduating at Hanover College, Indiana he was appointed in 1872 botanist to the U S Geological Survey in the Rocky Mts, but returned to his old college as professor of natural sciences in 1874 He was then successively professor of biology, Wabash College (1879–91), president and professor of botany, Indiana University (1891–93), and president, Lake Forest University (1893–96) In 1896 he was appointed head of the new department of botany of the University of Chicago, to the development and work of which he devoted nearly thirty years, retiring in 1925 Since his retirement he has been adviser of the Boyce Thompson Institute of Plant Research, Yonkers, N Y

Coulter's earlier botanical work was floristic The "Synopsis of the Flora of Colorado" (1874), a government publication, with Prof Thomas C Porter, incorporated the results of his own and earlier investigations in this part of the Rockies A more extensive piece of work was his "Manual of the Botany of the Rocky Mountain Region from New Mexico to the British Boundary" (1885), a companion volume for the territory included to Gray's classic "Manual of the Botany of the Northern United States," for the sixth edition of which, in 1890 (with some extension of the area westwards), Coulter and Gray's successor, Sereno Watson, were jointly responsible In association with the late Dr J N Rose, Coulter published a revision of the North American Umbelliferæ (1888) and a Synopsis of the Mexican and Central American Umbelliferæ (1900)

Prof Coulter is best known in the botanical world, however, for his connexion with the *Botanical Gazette* and his work in the department of botany of the University of Chicago In November 1875, Coulter started the *Botanical Bulletin*, a modest little monthly of four pages, issued at a subscription price of one dollar a year, to afford a medium of publication for botanists of the western States comparable to those already existing in the eastern It comprised short notes, mainly of local floristic interest, many of which were provided by the editor himself With the second volume the name was altered to the *Botanical Gazette* to avoid confusion with the *Bulletin of the Torrey Botanical Club*, and the size was increased to eight pages The venture prospered, other eminent botanists became associated with Coulter in the editorship, and when in 1896 the senior editor went to organise the new department at the University of Chicago and the *Gazette* became the property of the University, it was already recognised as a leading botanical journal After more than fifty years of active editorship, Coulter in 1926 handed over the work to his former colleague, Prof Henry Cowles, himself retaining the title emeritus editor

With the development of the Chicago School of

Botany the *Gazette* also became a medium for the publication of its work An important aspect of this work also found expression in the volumes on the morphology of the seed plants, which are familiar to all students of botany The original small volume on the seed plants (1901) by Coulter and his assistant, C J Chamberlain, was expanded into the two important volumes dealing respectively with Angiosperms (1903) and Gymnosperms (1910) and represents a concise review of our knowledge of the detailed morphology, especially of the reproductive structures and the embryology in the two groups The special value of these volumes depends on the fact that the subject matter had its origin or had been critically reviewed in the laboratory of the Chicago botany school

In addition to his work as teacher and editor, Coulter played his part in the various associations and societies for the advancement of science in America He had served as president of the Botanical Society of America, and of the American Association for the Advancement of Science He was also a corresponding member of the British Association In 1921 he was elected a foreign member of the Linnean Society of London Botanists who attended the International Congress at Ithaca in 1926 will remember that Prof and Mrs Coulter took a prominent part in the reception of the delegates at the opening of the Congress in the Willard Straight Hall of Cornell University A B R

Dr G W Lee

Gabriel Warton Lee, who died in Edinburgh on Dec 1, 1928, was the son of the late Dr A B Lee of Geneva, the well known author of "The Microtomist's Vade Mecum," and of many valuable papers on cytological subjects He was born in 1880, and received his education at Geneva, where, after a distinguished university career, he took the degree of D Sc In 1905 he joined the staff of Sir John Murray in Edinburgh, and carried out a number of important investigations on the deep sea deposits brought back by the *Challenger* Expedition The researches on glauconite which he undertook in collaboration with his cousin and colleague, Dr L W Collet (now professor at Geneva), were published in the *Proceedings of the Royal Society of Edinburgh* in 1905–6

In 1907, Dr Lee was invited, on account of his special palæontological knowledge, to join the staff of the Geological Survey of Scotland, he was placed in charge of the Palæontological Department, and became responsible for the determination of the material annually collected from natural sections and from borings Dr Lee acquired an unrivalled knowledge of the Carboniferous fauna of Scotland and was a recognised authority on the Bryozoa, publishing in 1911 an important monograph on the British Carboniferous Trepostomata He made valuable contributions to the Survey memoirs dealing with the Carboniferous rocks of the Edinburgh (1910) and Glasgow (1911 and 1925) districts, of East Lothian (1910), and of North Ayrshire (in the press) He assisted in the mapping of the complex geology of the Island of Mull, and had completed a detailed examination of the Mesozoic rocks of Scotland His memoir on "The Mesozoic Rocks of Applecross, Raasay, and N E Skye" appeared in 1920, and his later work on these rocks was embodied chiefly in the following memoirs "Pre Tertiary Geology of Mull, Loch Aline, and Oban" (1925), "Geology of the Country around Golspie" (1925), and "Geology of Ardnamurchan" (to be published shortly)

In addition to his official work, Dr Lee undertook the description of suites of fossils brought back from the Arctic by various expeditions Among these may be mentioned the collections made by the late Dr W S Bruce in Prince Charles Foreland in 1906–7 (*Proceedings, Royal Physical Society, Edinburgh*, 1908), and at Cape Cherney on the west coast of southern Novaya Zemlya in 1898 (*Transactions, Royal Society, Edinburgh*, 1909) Part of the material obtained by Prof O Holtedahl during the Norwegian expedition to Novaya Zemlya in 1921 was also submitted to him for determination and description (*Report of Scientific Results*, No 22, Kristiania, 1904)

Dr E van Rijckevorsel

Dr Elie van Rijckevorsel, who died on Oct 18 last at the age of eighty three years, was born at Rotterdam After leaving the gymnasium there he went to the Polytechnic at Zurich and the University of Bonn, taking his doctor's degree in physics and mathematics at Utrecht in 1872 Soon afterwards he proposed to Prof Buys Ballot a magnetic survey of the East Indian Archipelago at his own expense, only the instruments being provided by the Dutch Government After a training at the observatories at Kew and Munich, he left for Java in December 1873, and largely extended Elliott's first survey of 1846–49, taking observations at more than a hundred stations In spite of interruption by malarial fever, a similar survey was carried out in eastern Brasil between 1882 and 1885, with the assistance of E Engelenburg

After being nominated honorary assistant of the Dutch Meteorological Institute, Van Rijckevorsel made the first and only magnetic survey of Holland In the meantime, many intercomparisons of standard instruments had been made, and magnetic observations in the Alps with Van Bemmelen followed, indeed, Van Rijckevorsel was one of the pioneers of international magnetic research, and was recognised as such by the honorary degree given him by the University of Glasgow in 1893, and by his nomination as one of the eight members of the first magnetic commission created by the International Meteorological Committee in 1896 at Paris

Since 1896, Van Rijckevorsel has developed another side of his scientific interests At the British Association at Toronto a paper was presented, "On the Temperature of Europe," followed by a series of papers in German, partly published by the Institute at De Bilt, which trace

constant, possibly cosmic, influences causing secondary maxima and minima in the yearly range of meteorological elements and terrestrial magnetism and lead to the calculation of numerous periods, even in mortality and nativity Part of the material was provided by the author, copying unpublished observations abroad during repeated sojourns in milder climates during winter time

Van Rijckevorsel was a lonely man for a great part of his life, and always busy—his love of Nature, his skill in drawing, and his taste in forming ethnological collections will be long remembered by his friends and countrymen Time will judge of the importance of his life-work, but his earnest devotion to international science ensured him the esteem of colleagues from many nations

E VAN E

MR C L TEMPLE, C M G

WE regret to record the death of Mr Charles Lindsey Temple, C M G, formerly Lieutenant Governor of Northern Nigeria, which took place on Jan 9 at Granada, Spain Mr Temple was a son of the Right Hon Sir Richard Temple, formerly Governor of Bombay, and a notable figure in the political world of the late nineteenth century, and a brother of the present Sir Richard Temple, the distinguished authority on Indian culture and literature

Charles Temple was born in 1871, and entered the Consular Service in Brazil in 1898 Through the influence of Sir Frederick Lugard, he joined the Nigerian Service in 1901, where he rapidly showed himself an administrator of sympathetic understanding in dealing with native affairs Papers on the natives of Northern Nigeria, contributed by him to the *Journal of the Royal Geographical Society* in 1912, and by his wife to the meeting of the British Association in 1913, showed how thoroughly the essential factors of the situation had been grasped Temple was a staunch upholder of the theory of government that it was the duty of the white races to accept, so far as possible, tribal laws and customs as a guide in shaping the development of backward peoples He regarded it as essential that natives should be associated with whites as much as possible in the government of their own country The views and the principles upon which he carried out his administrative duties were embodied in a book, "Native Races and their Rulers," which appeared in 1918 and has since become a text book for administrators, and a powerful influence in the government of Nigeria

Mr Temple was Chief Secretary of Northern Nigeria from 1910 until 1913, and was appointed Lieutenant Governor of the Protectorate in 1914, holding that office until 1917, when his health broke down He married Miss Olive MacLeod, daughter of Sir Reginald MacLeod of MacLeod, herself well known as a traveller and the author of a number of studies of the peoples of Nigeria, based on material mostly collected during her husband's term of office

PROF A W BICKERTON

PROF A W BICKERTON, whose death on Jan 23, at the advanced age of eighty seven years, is announced, was a well known figure in astronomical and other scientific circles He was born at Alton, Hants, on Jan 7, 1842, and educated at the Grammar School there and the Royal School of Mines, South Kensington, of which he became an Associate After leaving the College he was appointed organiser of science classes at the Hartley Institute (now University College), Southampton, and in 1874 went to Canterbury College, Christchurch, New Zealand, as professor of chemistry and physics While there he had among his students Sir Ernest Rutherford, who in the *Times* of Jan 25, pays an appreciative tribute to the stimulating lectures given by his old teacher, and remarks 'His powers of popular exposition, his enthusiasm and versatility were of great value in promoting an interest in science in a young community"

About twenty years ago Prof Bickerton came to England with the express purpose of developing and making known an impact theory of cosmic evolution conceived by him in 1877, and of which he regarded the appearance of new or temporary stars as examples His view—described in a number of papers published by the New Zealand Institute and other societies—was that stars were formed by the grazing collision, or partial impact, of two cosmical masses The new lucid object thus brought into existence was not regarded as made up of the combined masses of the colliding clouds, but as a third body formed by the material detached from the colliding masses A suggestion of this kind could obviously scarcely be placed in the category of fundamental astronomical theories without substantial observational or dynamic evidence, neither of which Prof Bickerton was able to provide He was discouraged by the indifference shown by astronomers generally to his views yet he never lost his enthusiasm, and believed that he had found the truth and that it would be established in due season by both mathematical physics and astrophysics He would, we believe, be content with the epitaph, "Magna est veritas et praevalet"

WE regret to announce the following deaths

Dr T O Bosworth, author of "Geology of the Tertiary and Quaternary Periods in the North West Part of Peru," on Jan 18, aged forty six years

Dr John K Haywood, chemist in charge of insecticide supervision, food, drug, and insecticide administration in the U S Department of Agriculture, on Nov 30, aged fifty four years

Dr Fernand Widal, professor of internal pathology in the University of Paris, whose name is associated with the agglutination test for the diagnosis of typhoid fever, on Jan 14, aged sixty six years

Prof R H Yapp, Mason professor of botany in the University of Birmingham since 1919, on Jan. 23, aged fifty-seven years

News and Views.

WE referred last week, p 138, to the meeting of the Royal Society on Jan 17, at which Prof Eddington described some speculations on a new development of quantum mechanics, published in the January issue of the *Proceedings* of the Society So much prominence has been given to the paper in the public press that some further remarks upon it in these columns may be worth while The speculations put forward are of a very interesting type, for they attempt to assimilate what we now call interchange of electrons to a transformation in a new co ordinate or co ordinates, similar to a Lorentz transformation in space timeco ordinates in that it can never be observed The starting point of these speculations is the observation that we now describe the interaction of electrons by two principles, Coulomb's electrostatic forces and Pauli's exclusion principle, and that every principle of scientific æsthetics requires us somehow to weld them into one This observation is perhaps the most promising and interesting part of the paper The main part of the paper is concerned with speculations as to how perhaps this might be done, and the description of the interchange of electrons already alluded to is Prof Eddington's attempt at a weld

PROF EDDINGTON S whole speculation is extremely tentative, even for a new step in quantum mechanics, and very properly so propounded If his main idea is correct, that the principles of Coulomb and of Pauli are two aspects of the same feature of our world, there must necessarily be a theoretical connexion between the two constants, ϵ^2 and $hc/2\pi$, which they respectively introduce Prof Eddington's tentative speculations suggest a value of 136 for this ratio, *all* the existing experimental evidence, provided that our main theoretical formulæ are trustworthy, are in favour of a value very near to 137, a value which of course is not necessarily integral It is quite possible that Prof Eddington's theoretical result of 136 may be right, even if every word which he or any one else can as yet say about his theory is a totally wrong interpretation of it, like so much else which we still say of the easier aspects of quantum mechanics It is far too soon to be confident either way But if the ratio is really 136, it is already clear that the new theory when complete must involve small but far reaching changes in the relations between the primary physical constants and, for example, Rydberg's constant It will be a matter of the highest interest if it ultimately turns out that the formula for Rydberg's constant, the corner stone of modern physical theory, was slightly wrong after all! At present it is proper to confess that we do not in any sense understand the new theory, still less know if it is right Its further study will no doubt be prosecuted with interest and vigour

IN order to introduce into the Leningrad Academy of Sciences, which three years ago celebrated its 200 years of independent scientific life, it was decided last year to enlarge the Academy by adding to it forty new members A list of candidates has been approved by the authorities, and amongst the new academicians several active supporters of the government have been duly elected Three of the candidates put forward by communistic organisations failed, however, according to the *Times* of Jan 28, to obtain the two thirds majority of votes necessary to secure election, probably because of their insufficient qualifications The Soviet authorities insist now that the Academy must waive its statutory regulations and take a fresh ballot on the three rejected candidates A meeting of the Academy summoned to consider this extraordinary proposal decided that, although it was contrary to the statutes, it has to be accepted Nine academicians, however, voted against acceptance, and their names have been published by the Soviet press as follows Pavlov (physiologist), Levinson Lessing (geologist), Borodin (botanist), Liapunov (mathematician), Karsky (ethnologist), Lavrov, Petrushevsky, Vladimirtseff, and Sakulin, every one of these nine names is well known—indeed, some are famous amongst the leading men of science of the whole world Various startling projects of reconstructing the Academy so as to make it support actively the government policy are discussed by the official Soviet press, but apparently no definite decision has been arrived at so far

THE neon tubes which are now so familiar to the public in various script sign advertisements have found a useful application in replacing white lights for lighthouses serving air routes In a new light at Lympne, sixteen tubes twenty feet long are employed in the form of a vertical truncated cone The light is said to have a candle power of 6000 and to be visible in clear weather for 45 miles The neon spectrum gives a number of lines lying for the most part towards the red end of the spectrum, the yellow line 5853 A being specially prominent Thus the normal colour of the tube is red orange, unless much argon or mercury vapour are also present It is therefore possible to obtain a radiation which is comparatively little subject to atmospheric scattering (the intensity of scattering is inversely proportional to the fourth power of the wave length) while yet remaining of high visibility The characteristic colour of the light is a strong recommendation, it would be made somewhat more red owing to scattering when seen through fog, but the change would be small in comparison with that experienced in connexion with any white light Experiments have shown that even when the neon light failed completely to penetrate a layer of fog it made a "large red luminous patch on the top of the fog" Such a light has now been installed at the Lympne aerodrome on the London Paris air route

FOR some time it has been rumoured that Prof Einstein has been about to publish the results of a protracted investigation into the possibility of generalising the theory of relativity so as to include the phenomena of electromagnetism It is now announced

that he has submitted to the Prussian Academy of Sciences a short paper in which the laws of gravitation and of electromagnetism are expressed in a single statement The *Daily Chronicle* of Jan 26 reports an interview with Prof Einstein in which he explains in outline the scope of his new achievement "For years," he is reported to have said, "it has been my greatest ambition to resolve the duality of natural laws into unity This duality lies in the fact that physicists have hitherto been compelled to postulate two sets of laws—those which control gravitation and those which control the phenomena of electricity and of magnetism Many physicists have suspected that two sets of laws must be based upon one general law, but neither experiment nor theory has, until now, succeeded in formulating this law I believe now that I have found a proper form I have thought out a special construction which is differentiated from that of my relativity theory, and from other theories of four dimensional space, through certain conditions These conditions bring under the same mathematical equations the laws which govern the electromagnetic field and those which govern the field of gravitation The relativity theory reduced to one formula all laws which govern space, time, and gravitation, and thus it corresponded to the demand for simplification of our physical concepts The purpose of my work is to further this simplification, and particularly to reduce to one formula the explanation of the field of gravity and of the field of electromagnetism For this reason I call it a contribution to 'a unified field theory' Now, but only now, we know that the force which moves electrons in their ellipses about the nuclei of atoms is the same force which moves our earth in its annual course about the sun, and is the same force which brings to us the rays of light and heat which make life possible upon this planet "

PROF EINSTEIN gives no indication of the line of thought he has followed or of the precise character of the new law His paper, it is stated, will be published in a few days As an illustration of the remark that many physicists have suspected the existence of a general field law, we may quote the following passage from Prof Eddington's recent book, "The Nature of the Physical World" After an account of the relativity interpretation of non empty space, he writes, "It should be added, however, that this is a summary description and not a full account of the non emptiness, because we have other exploring apparatus—magnets, electroscopes, etc —which provide further details It is usually considered that when we use these we are exploring not space, but a field in space The distinction thus created is a rather artificial one which is unlikely to be accepted permanently It would seem that the results of exploring the world with a measuring scale and a magnetic compass respectively ought to be welded together into a unified description, just as we have welded together results of exploration with a scale and a clock " Apparently Einstein's new work has accomplished such a welding, but details cannot be gathered until the paper becomes available.

OF all British men of science, none commands our admiration and respect more than Michael Faraday, who by the simplicity and nobility of his character endeared himself to all those around him and by the variety and importance of his discoveries made possible many of the extraordinary advances of modern science His life's work was done in the laboratory of the Royal Institution, and it was there, on Aug 29, 1831, he made his first successful experiment on electromagnetic induction, an experiment which, following in the wake of those of Oersted, Arago, Sturgeon and Ampere, marks the first of a series of discoveries to which we owe our command of electricity to day Recognising the epoch making character of that experiment, the Royal Institution proposes to take steps to celebrate its centenary, and accordingly has issued an invitation to those interested to be present at a meeting of the Royal Institution on Feb 5 at 4 30 P M, when the proposal will be considered In the invitation the Royal Institution points out that the centenary of the British Association also falls in 1931, and that certain important conferences on electricity will be held in London that year, and in directing attention to this matter says "It seems probable also that the event may provide a unique and most favourable opportunity for a review of the great contributions which British workers have made to the scientific and industrial advances of the past century It is certain that such a review might be made a source of inspiration and encouragement to the nation " At a dinner of the American Institute of Electrical Engineers in 1901, the toasts were 'The Land of Ampère," "The Country of Faraday," "The Successors of Ohm," "The Heirs of Volta," and "The Legatees of Franklin " That was a happy demonstration of the freemasonry of science, and it would be a fortunate thing if the efforts of the Royal Institution lead to an international gathering to commemorate the work of one of whom Tyndall said that "he prized the honour of being Faraday's successor less than the happiness of having been his friend "

THE centenaries of scientific interest which occur in 1929 will recall some of the most remarkable men in the history of scientific discovery, men of various nationalities, pioneers in many branches of science and men differing greatly in character England, Germany, Holland, France, the United States, and Norway, will all have their celebrations, some of which will no doubt attract world wide attention Perhaps the most notable name to be recalled is that of Huygens, who was born at The Hague on April 14, 1629, and died there on June 8, 1695 As a connecting link of the age of Galileo and that of Newton, Huygens is one of the leading figures in seventeenth century science Among Englishmen we note the approaching centenary of the death of Davy, who passed away on May 29, 1829, and that of Young, who died on May 10 We have already referred to these famous men in these columns, and it is to be hoped the commemorations will be worthy of the occasions No less a notable figure is that of Lamarck, who died on Dec 18, 1829, and whose statue stands at the entrance to the Jardin des Plantes, for which he did so much On April 6

occurs the centenary of the death of the brilliant but short lived Norwegian mathematician Niels Henrik Abel, while later in the year come the centenaries of the births of the German chemists Kekulé and Griess, of the French chemist Schützenberger, the Austrian geologist Hochstetter, the American geologist Hayden, while another notable American man of science born in 1829 was Asaph Hall, the discoverer of the satellites of Mars The United States and England alike will no doubt in some way pay tribute to the memory of James Smithson, through whose bequest arose the great Smithsonian Institution at Washington Smithson died at Genoa in June 1829

Besides these anniversaries we may direct attention to the bi centenary of Thomas Newcomen, who may properly be called the father of power engineering The steam or fire engine had been the subject of experiments by Papin, Worcester, Savery, and others, but the introduction of the atmospheric beam engine for pumping purposes was mainly the work of Newcomen, the Dartmouth blacksmith Newcomen's engines provided the first solution of the problem of pumping from deep mines, and the form he introduced continued to be constructed right throughout the eighteenth century, and one or two examples were at work within quite recent times Moreover, it was the model of a Newcomen engine, still preserved in the University of Glasgow, which led Watt to his epoch making inventions But Newcomen engines were in use forty years before Watt began his experiments, and when at the Watt centenary of 1919 a small group of engineers founded a society for furthering the study of the history of engineering and technology, they most appropriately called it the Newcomen Society Though not a large body, the Newcomen Society has by its activities and its excellent *Transactions* admirably fulfilled its purpose, and this coming summer it is holding a joint meeting with the Devonshire Association in order to pay due homage to the memory of Newcomen Born at Dartmouth in 1663, Newcomen died in London on Aug 5, 1729, and lies in an unknown vault in Bunhill Fields Burial Ground Another centenary of interest to engineers is that of the famous locomotive trials at Rainhill in October 1829, when the great competition took place between Hackworth's *Sans Pareil*, Ericsson's *Novelty*, and Stephenson's *Rocket*, the latter the best known locomotive in the world To this event the Newcomen Society also rightly proposes to direct attention

The second report of the National Fuel and Power Committee to the President of the Board of Trade (Cmd 3252, London H M Stationery Office, 9*d* net) recommends that legislation be promoted without delay to provide alternative procedure under section 10 of the Gas Regulation Act, whereby the Board of Trade, by Departmental Order, may grant to gas undertakings, power to raise additional capital and borrow money on mortgage to the extent of the undertakers' paid up share capital, power to offer new capital for subscription to existing holders, consumers, and employees, power to effect joint working arrangements with other undertakings, and to institute a two-part tariff system of charge for gas The therm system of charge is considered a fair one, and the Report recommends that, from an appointed day, existing statutory gas undertakers, except very small ones, supplying less than, say, 20 million cub ft of gas per annum, should be required to supply gas on a thermal basis and become subject to the purity, pressure, and testing requirements of the Gas Regulation Act All gas undertakers should fulfil the requirements of the Act as regards purity and pressure of gas, it being understood that, in the case of a non statutory undertaking, no penalty would be incurred when a deficiency in respect of these requirements was due to circumstances not within its control The growing practice of supplying artificially dried towns' gas necessitates the amendment of the section of the Act defining the calorific value in terms of unit volume of gas saturated with water vapour No quarterly average value of calorific value should be assessed unless at least six tests of the gas have been made during the quarter At present, gas undertakers are customarily permitted to work up residuals purchased from other undertakers or elsewhere to the extent of only one third of the like residuals obtained from their own manufacture of gas It is recommended that this restriction as to quantity, where it exists, be removed

According to a recent announcement by Prof James H Breasted, the organisation on an extended scale of the Institute of Oriental Research of the University of Chicago is now made possible by an endowment of 9,500,000 dollars, of which the greater part is already assured Among the objects to which this sum is to be devoted are the provision of a new building on the campus of the University, an annual grant towards carrying out projected researches over a period of the next ten years, and an endowment for teaching which will enable the Institute to avail itself of the services of the leading Orientalists and historians of the world The plan of work, now in process of being framed, will include a series of expeditions sent out from the central organisation, which will work side by side and in close co operation along the whole of what is termed the 'archæological front' of the Near East, including Babylonia and Assyria as well as Persia and its neighbours

The marvels of Ur multiply Within ten days of his first report of the season, Mr Woolley has further sensational discoveries to record His account of the opening up of another pit shaft, in the *Times* of Jan 22, leaves the reader in amazement no less at the light they throw on Sumerian burial practices than at the surprising wealth of objects of Sumerian art and their character Now we learn of the sacrifice of a groom and of asses found with traces of a chariot and the remains of the ornament of the harness, on a sacrificial floor composed of a mat roof covering another sacrificial chamber with its array of victims This in turn leads to a death pit with forty five victims, of whom no less than thirty nine are women, and six are indeterminate Of headdresses of gold and precious stones similar to those of the nine court ladies found last year, thirty four have been found, and the other contents of the pit, so far as cleared, are no less remarkable in quantity and character

both of workmanship and conception Two statues are unique—rampant rams with heads and legs of gold, horns and shoulder hair of lapiz, the fleece of white shell, each tuft carved separately, and the belly of silver

CAPT PUREFOY, on behalf of the Committee for the Protection of British Butterflies, appointed by the Entomological Society of London, has presented to the Department of Entomology of the British Museum (Natural History) a set of specimens of the first brood of the imported Dutch form of the large copper butterfly, reared in Wood Walton Fen, near Huntingdon The British form of this butterfly, formerly moderately common in the fen country, where its caterpillar fed upon the giant water dock, has been extinct since 1848 About ten years ago a form was discovered in Holland, whence was derived the stock with which it is hoped to repopulate some part at least of the area formerly occupied by the insect The specimens presented to the Museum are intended to form the commencement of an annual record of the broods, so that any variational tendencies in the colony may be more easily recognised Capt Purefoy has also presented a set of specimens from the Irish colony established by him a number of years ago, which has been well maintained ever since From Dr J Schwetz the Department has also received specimens of a new species of tsetse fly, taken by him in the region of the Lower Lomami River, Belgian Congo Since the new specimen belongs to the same group as *Glossina palpalis*, the tsetse chiefly responsible for the spread of human sleeping sickness, its discovery may be of medical importance The skeleton of the large *Ichthyosaurus* extracted at the end of November last from the Lower Lias in the quarry of the Red Triangle Cement Works at Harbury, Warwickshire, has been presented by the Portland Cement Selling and Distributing Co to the Department of Geology of the Museum The skeleton is deeply imbedded in nodules of limestone

PROF A C SEWARD'S Friday evening discourse, delivered on Jan 25 at the Royal Institution, was entitled "Greenland As it is and as it was" He gave a brief description of the geological structure of the country, the present inhabitants, the ice sheet and icebergs, and of the Arctic flora The only representatives of trees are stunted willows and the prostrate dwarf birch Many of the flowering plants have a circumpolar distribution, some of them being also members of the alpine flora of Scotland and Switzerland, while others are unknown in Europe and occur in North America The present conditions in Greenland are much more favourable than in corresponding regions in the far south on the borders of the Antarctic continent Prof Seward then discussed the value of fossil plants as evidence of climatic conditions of the past In rocks of Cretaceous age on Disko Island and at localities on the mainland about half way up the western coast of Greenland there are fossil ferns closely related to species of *Gleichenia*, now widely spread in the southern tropics, and other ferns related to a species now confined to Malaya; there are conifers now unknown in Europe, and abundance of trees with leaves scarcely distinguishable from those of the maidenhair tree (*Ginkgo biloba*) Special attention was directed to the presence, in the Cretaceous flora, of plane trees of trees closely related to existing Magnolias and trees akin to the tropical bread fruit tree, and representatives of other families now characteristic of subtropical or tropical regions

THE paper dealing with "Colour and its Applications," read by Dr L C Martin before the Illuminating Engineering Society on Jan 22 contained an interesting survey of colour measurement in the course of which an ingenious new colorimeter developed at the Imperial College of Science by Mr W D Wright was described The lecture was aided by some effective demonstrations, by Mr C F Smith, of colour mixtures and harmonies, for which his 'mutochrome' apparatus proved well adapted Dr Martin also discussed the relation between colour and acuteness of vision, and presented a series of curves illustrating the relation between colour and visual speed Much of the discussion was concerned with 'artificial daylight,' and the need for a practical standard of white light was emphasised The arbitrary standard, based on the use of an electric incandescent lamp, run at a prescribed pressure and equipped with a standard blue filter, is stated to furnish radiation equivalent to that of a black body maintained at about 2900° K, and has evidently possibilities It was interesting to learn that a standard specification for artificial day light is now likely to prove a practical project

THE current issue of the *Journal of the Marine Biological Association* contains a description of the Laboratory at Plymouth and a list of publications recording the results of researches carried out there or under the auspices of the Association on the North Sea coast from 1886 to 1927 This bibliography of nearly a thousand papers, ranging over morphology, biology, and various branches of economic marine zoology—on fishes, oysters, cockles and scallops, the shipworm, crabs lobsters, and sponges—serves to emphasise the close correlation between pure and applied science, and shows that the wise policy of the founders of the Association—to aid science and industry—has been consistently followed The Laboratory provides facilities for all kinds of biological, work and appreciative reference should be made also to the successful courses for advanced students, held during the Easter and summer vacations The major parts of the organisation of the Plymouth Laboratory has been built up during the thirty three years' directorship of Dr E J Allen, to whom and to his staff are due congratulations, not only for their many contributions to the advancement of our knowledge of the sea, but also for the fine spirit of helpfulness which prevails in the Laboratory

THE gradual disappearance of the European bison, which reached its most serious stage during the War, has been watched with much concern, and an association was formed a few years ago with the object of endeavouring to prolong the existence of this interesting species. This good cause has received a severe

blow in the news brought back by Prof J Pujanov, of Semferopol, who has just completed a survey of the Caucasus reserve In 1911 the herd in the Caucasus region numbered 1000, and in 1924, when 25 animals were still known to be alive, the Soviet Government set aside an area of 1100 square miles as a permanent bison reserve Last year a group of zoologists who had had special experience explored this region thoroughly, searching every valley Not a single living bison was seen Bones in plenty were discovered of animals apparently only a year or two dead, and some bore bullet marks The bison seem to have been shot by poachers, the patrol of the reserve having been in sufficient to stop illegal shooting It is stated that one or two animals may still possibly lurk in remote fastnesses in the area, but for all practical purposes the Caucasus herd may be regarded as extinct

AN able summary, over the initials 'I D S,' appears in the October issue of *Psyche*, against the suggestion of some psychiatrists that those patients whose mental disorder is difficult to specify, or does not constitute them a danger to themselves or others, should be detainable by some informal compulsion warranted by their relatives and by medical opinions The advantages claimed are, that the earlier treatment thus enforced would be more effective than if delayed until the patient should be certified, and that the informal nature of the proceedings would avoid the stigma of insanity The writer claims in opposition that only a small proportion of mild cases ever reach the asylum, that institutional life does not have a good effect on the individual, that the district asylums have not the staff for the necessary treatment, and the average medical officer is ill instructed in psychiatry and mental treatment He also quotes with approval Dr Millais Culpin s views expressed in a letter to the *Times* last autumn as to the probability of the stigma very quickly being affixed to this compulsory detention He suggests that the provision of outdoor treatment is the better course to follow, and points out that if there is any treatment worth having, people will gladly avail themselves of it

WITH the financial help of the firm of Zeiss of Jena, the *Zeitschrift fur Instrumentenkunde* has been able to carry out its project of issuing occasional supplements dealing with the history of the progress of optics The first part appeared in December under the title *Forchungen zur Geschichte der Optik* It consists of 40 pages of the same size as those of the *Zeitschrift* Five pages are occupied by an article by Dr M v Rohr, the editor, devoted to an extract from Sir J F Herschel's Journal, giving an account of his visit to Fraunhofer at Munich in September 1824, and to other evidence of the rapid spreading of a knowledge of Fraunhofer's work amongst English physicists in the next few years The remainder of the issue is devoted to an article by Dr H Boegehold giving the history of the achromatism of prisms and lenses from the discovery of the effect for glass and water by Newton in 1704, its use by Dollond in 1757, and its general recognition as an optical method by about 1775

PROF EJNAR HERTZSPRUNG, of Leyden Observatory, has been appointed George Darwin lecturer of the Royal Astronomical Society for 1929 The lecture will be delivered at the May meeting of the Society

AN earthquake of moderate intensity was recorded at Kew Observatory at 20 hr 48 min 50 secs G M T on Jan 24 The epicentre is estimated to have been 5580 miles away, probably in Central America

SIR ERNEST RUTHERFORD will open a discussion at the Royal Society on Feb 7 on "The Structure of Atomic Nuclei" Dr F W Aston, Dr J Chadwick, Dr C D Ellis, R H Fowler, and Prof O W Richardson will take part in the discussion

THE Pharmaceutical Society of Great Britain will hold a conversazione at the Society's house at 17 Bloomsbury Square, London, W C 1, on Tuesday, Feb 12, when the museums, school, and research and pharmacological laboratories will be open to inspection

THE Progress Medal of the Royal Photographic Society of Great Britain has been awarded by the Council to Mr Olaf Bloch, in recognition of his various inventions, researches, and publications, which have resulted in important advances in the development of photography

THE Council of the Institution of Naval Architects has awarded a premium for the year 1928 to Lieut Colonel V C Richmond for his paper on "Some Modern Developments in Rigid Airship Construction" and a joint premium to Mr E Leslie Champness and Mr Frank McAlister for their paper, "Further Notes on the Relative Strength of Fine and Full Cargo Vessels" The premiums will be presented on Mar 20 at the opening of the annual general meetings, which will be held at the Royal Society of Arts John Street, W C 2

THE Institute of Physics announces additional privileges for student members Registered student members pay a fee of five shillings per annum, which is credited against the entrance fee on election to corporate membership In future, in addition to existing privileges, students will receive the published lectures given before the Institute free of charge, and will be allowed to subscribe to the *Journal of Scientific Instruments* at the privileged rate of ten shillings and sixpence per annum

THE Council of the Institution of Electrical Engineers has made the eighth award of the Faraday Medal to Signor Guido Semenza, of Milan This medal is awarded by the Council of the Institution not more frequently than once a year either for notable scientific or industrial achievement in electrical engineering or for conspicuous service rendered to the advancement of electrical science, without restriction as regards nationality, country of residence, or membership of the Institution Signor Semenza has for many years taken a leading part in the development of the applications of electricity

THE non magnetic yacht *Carnegie* has reported her arrival at Callao, Peru, on Jan 14 Because of a storm and loss of an anchor at Easter Island, the vessel left there on Dec 12, two days before the time originally set Unfavourable winds drove her south from her course as planned to 40° south latitude in

longitude about 95° west Captain Ault reports continued excellent observational results for the full programme since leaving Easter Island Twenty three bottom samples were obtained on the trip from Balboa to Easter Island to Callao, those from Easter Island to longitude 95° west were red clay with volcanic mud It is expected that the *Carnegie* will sail on Feb 3 from Callao for Papeete, Tahiti

THE claim by Leone Caetani, author of the "Annali del' Islam," that the great Moslem migration into North Africa was due to the increasing desiccation of Arabia at that period, has been discussed by Prof Alois Musil in an Appendix, No 10, to his work on Northern Negd in the fifth volume of his "Explorations in Arabia," in process of publication by the American Geographical Society Prof Musil insists that this claim is quite invalid, and that there is no evidence of any material climatic change in Arabia during historic times Prof Musil's detailed discussion of this question is useful, as the view that the Arab emigration was due to increasing desiccation has been adopted recently by Sir Thomas Arnold (1924), and by Prof MacMillan Brown, "Problems of the Pacific," 1927

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —A junior assistant (engineer) at the Fuel Research Station, East Greenwich—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, S W 1 (Feb 14) An assistant for work on virus diseases of the potato, and an assistant for field work in connexion with the development of potato culture, each under the Department of Agriculture for Scotland—The Establishment Officer, Department of Agriculture for Scotland, Queen Street, Edinburgh (Feb 16) A reader in mathematics at Birkbeck College—The Academic Registrar, University of London, South Kensington, S W 7 (Feb 18) A lecturer in agriculture in the University of Leeds—The Registrar, The University, Leeds (Feb 18) A professor of electrical engineering at the College of Engineering Guindy Madras—The Secretary to the High Commissioner for India General Department, 42 Grosvenor Gardens, S W 1 (Feb 23) An evening lecturer in magnetism and electricity at the Wimbledon Technical Institute The Principal, Technical Institute Wimbledon, S W 19 A Secretary to the Technical Institute, Wandsworth—The Principal, Technical Institute, Wandsworth, S W 18

Our Astronomical Column

COMET SCHWASSMANN WACHMANN (2)—The new comet 1929*a* proves to be one of short period, like the first one discovered by the same observers Images of the comet were found on plates taken on Jan 4 and 12 (the latter at Uccle Observatory) From these positions, combined with photographic observations on Jan 20, Prof G van Biesbroeck and Mr Y C Chang have computed the following orbit (*I A U Circ* No 218)

T	1929 April 1 36 U T
ω	2° 15′ } 1929 0
Ω	126 36 } 1929 0
i	3 39 } 1929 0
log q	0 3075
Period	6 825 years

EPHEMERIS FOR 0^h

	R A	N Decl	log r	log Δ
Jan 28	5^h 38^m 16^s	20° 59′	0 3201	0 0988
Feb 5	5 39 1	21 23	0 3174	0 1161
13	5 41 57	21 47	0 3149	0 1348
21	5 47 25	22 10	0 3126	0 1546

The distance from the sun is diminishing, but that from the earth increasing, the brightness should not diminish rapidly The comet should be observable until May at least If these elements are accurate, there was a near approach to Jupiter (about one third of a unit) in November 1926

FORBES'S COMET—The following are the latest observations to hand of Forbes's Comet

U T	R A 1928 0	S Decl 1928 0	Observer
Dec 8 47988	12^h 54^m 21 15^s	31° 55 9·4″	G van Biesbroeck, Yerkes
9·48678	12 56 50·03	32 22 2 7	"
10·48032	12 59 15·77	32 47 48 7	"
8 06210	12 53 19·28	31 43 36 1	H E Wood " Johannesburg

Astr Nach, 5608, reports an observation of this comet Oct 27 81 U T, R A 11^h 1^m 24^s, N Decl 8° 32 2′ There is little doubt that the comet was seen, but the position given is very rough

A POSSIBLE COMPANION TO SIRIUS B—A letter from Dr R T A Innes in the *Observatory* for January states that a faint star has been suspected near Sirius B on several nights ranging from Feb 4, 1926, to Mar 20, 1928 Its distance from B varies from 1″ to 2″ and the period is estimated to be from 18 months to two years It is estimated as of magnitude 12 On some evenings several observers saw it Various eyepieces were tried, and every precaution was taken to guard against illusion, but the object is so difficult that its existence is not absolutely guaranteed Dr van den Bos recalls that Prof Fox suspected the duplicity of B with the 18½ inch Clark refractor He gave P A 231°, distance 0 8″, date 1920 110

Dr van den Bos also gives some measures of the companion of Procyon, though this was so difficult that he does not guarantee its objective existence

	P A	Dist
Feb 8, 1927	198 6°	3 06″
Oct 27, 1928	230 7	2 07

He had purposely consulted no ephemeris on either occasion, but afterwards found that the first position was in fair accord with Dr Spencer Jones's ephemeris

It may be worth while to point out that the distance and period as estimated by Dr Innes are not compatible with each other From the meridian observations of the bright star, the mass of Sirius B has been deduced as 0 96 of the sun's mass If Sirius B is double, this would be the joint mass of its two components The parallax 0 38″ is very well determined Taking the mass as equal to that of the sun, a semi major axis of 1 52″ would give a period of 8 years One of 1 00″, the smallest value suggested by Dr Innes, would give a period of 4 27 years Thus, either the distances given by him are considerably overestimated or the period is underestimated The distance given by Prof Fox, 0 8″, would give a period of 3 years, if assumed to be the unforeshortened length of the semi major axis The distances were estimated, not measured, at Johannesburg, the suspected star being too faint to set a wire upon

Research Items

The Spearthrower in America.—Some remarkable spearthrowers of ancient American origin are described by J. Alden Mason in the *Museum Journal* (Philadelphia) for September 1928. At the present day the spearthrower is used in America only by the Eskimo, certain of the tribes of the Amazon, and the Tarascan Indians of Lake Patzcuaro, Mexico; but formerly it was employed much more widely. Specimens are known from the pre-Cliff Dweller remains of Utah belonging to the people known as the Basket-makers, from pre-Columbian Florida, and from pre-Columbian graves of the coasts of Peru and of Ecuador and Colombia, from the Aztecs of the time of Montezuma and from the Toltecs. The Haitians of the time of Columbus used it, as did certain Californian tribes of a century and a half ago. Not more than about thirty examples have been found in any one of these areas. Of the specimens here described, one belongs to the so-called Thule culture of the early Eskimo, and was found by W. B. Van Valin in the region of Point Barrow in 1919 in a series of mounds. It differs from any of the modern types, being of a superior grade alike from the æsthetic, technological, and utilitarian points of view. It is of a coniferous wood and measures 14½ in. in length by 2¾ in. maximum width. Its peg is of ivory. The second example belongs to the Basket-makers' culture of Utah and was the first to be found in the south-west. It is remarkable for a number of ceremonial objects attached to the handle. These include the tooth of a canine or feline, wrappings of yucca fibre, cotton yarn, and fur; and an X-ray examination has revealed four beads, probably of turquoise and representing the heart of a fetish bird, which lie under the yarn and cannot be otherwise examined owing to the fragility of the material. Two spearthrowers which are unique, and the rarest known in America, come from Marco Key, Florida, where they were discovered in 1896. They are longer and more slender than spearthrowers from other regions, the closest approximations being those in use among certain eastern Colombian tribes. A carved rabbit at the distal end of one is reminiscent of the carved spearthrowers of the Magdalenian period of palæolithic Europe.

Rescue and Reclamation of Fish.—The Division of Fish and Game of the Californian Department of Natural Resources has developed a strange industry—the rescue and reclamation of lost, or potentially lost, fishes. Black bass and other spiny-rayed fishes take advantage of flood conditions to spawn in areas which at the time seem perfectly suitable, but as soon as the overflows begin to dry through evaporation, both the newly hatched young and the adult fishes become a prey to predatory birds and mammals, and the result is a total loss. The rescue of this threatened population and its transference to a safe environment has assumed very considerable proportions. One worker reports that up to the end of August 1928, he had saved in his district of Hanford, 158,200 fishes, the majority of which were cat-fish, and these were planted in rivers throughout the country. During the month of August as many as 258,000 valuable angling fishes were saved to the State. Although a certain amount of useless and possibly harmful transportation has been carried out by enthusiasts, the aim of the Division of Fish and Game is to save only food fishes, and to utilise them in stocking barren waters with the species most adaptable to their particular conditions.

Combat Reactions in Frogs and Toads.—Reactions to special stimuli which produce specific phases of pose and movement suggesting a struggle, have been described amongst reptiles, but, according to Georg Hinsche, have not been suspected to occur amongst amphibians (*Biolog. Centralbl.*, Bd. 48, 1928, pp. 577-617). He finds a well-marked series of such reactions, twisting, staggering, stiffening, and kicking, suggesting attack and defence, to be exhibited by *Bufo vulgaris* and *Pelobates fuscus*, and rather less definitely displayed by other native amphibians such as *Bufo viridis*, *B. calamita*, *Rana esculenta* and *Hyla arborea*. Certain tactile as well as optical stimuli are adequate to set free such reactions, but along with the specific stimulus environment is an important factor. Hinsche considers that these combative reflexes are associated with very elementary reflex complexes related to the creature's food supply, burrowing habits, and sexual acts, and that, from the point of view of biological significance, they constitute a specific reply to a definite type of stimulus, and are not simply a reaction against an individual enemy. Their differences in degree in the different species he has experimented with are put down to differences in morphological and anatomical structure in these species. But in general the author finds that where a tendency towards flying leaps occurs, as in many species, the combat reaction is reduced in intensity.

The Mosquitoes of North and South America.—Dr. H. G. Dyar, of the United States National Museum, has recently contributed an important revisional monograph entitled, "The Mosquitoes of the Americas." It is issued as *Publication of the Carnegie Institute of Washington*, No. 387 (1928), and brings up to date the many changes in synonymy that have taken place since the publication of Howard, Dyar, and Knab's standard four-volume treatise on the "Mosquitoes of North and Central America and the West Indies" (1912–17). It is, furthermore, to be regarded as being supplementary to the latter work, since it also includes all the known species from South America. The classification of the group has not been materially altered from that adopted in the larger monograph just mentioned, except that five tribes of these insects are recognised instead of two. The Sabethini are here regarded as a separate division, since the American species all exhibit the peculiar larval feature of the median ventral brush on the anal segment being wanting. Dr. Dyar's work will be found invaluable by special students of mosquitoes, since he describes in concise language the male, female, and larva of every species where material is available, and their salient structural characters are fully illustrated on the 123 plates which accompany this monograph.

Philippine Echinoids.—Mr. Hilario A. Roxas, in his paper "Philippine Littoral Echinoida" (*Philippine Journal of Science*, June 1928), reports on the littoral sea-urchins and sand-dollars in the collection of the Department of Zoology, University of the Philippines. Echinoderms are not very numerous in the Philippines, but eleven species of sea-urchins and five of sand-dollars (Clypeasteridæ, Arachnoididæ, Laganidæ, and Scutellidæ) have been found at Puerto Galera, Mindoro, which is the main collecting ground. The only really common species are *Tripneustes gratilla*, *Echinotrix calamaris*, and *Echinometra oblonga*, none of the others being abundant. Photographs are given of all the species, showing the main characters of the tests in most cases, both with and without the spines, which should make identification easy. *Prionocidaris verticillata* is a very striking form,

bright green when alive and having long heavy spines ornamented with whorls of projecting ridges

FLOWER SIZE AND CHROMOSOME SIZE IN PETUNIA — A peculiar genetic behaviour in Petunia is briefly described by Mr E Malinowski (*Jour Heredity*, vol 19, No 11) He shows that in a variegated strain of *P violacea* Lind obtained from de Vilmorin, there is great variability in the size and colour of the flowers on some plants, other plants producing only large purple flowers or small lilac ones, and the same variable progeny being produced from seeds of any of the type But plants cannot be inbred because of self sterility It is suggested that this range of variation, although phenotypical, is produced by the presence of one gene It is further stated (and this needs confirmation) that the large purple flowers show larger chromosomes in their cells than the small lilac flowers, although in any one flower bud the meiotic divisions may show some cells with large and others with small chromosomes The statement is also made that, following the reduction division, one of the daughter cells may have large and the other small chromosomes It is suggested that the differences in flower size may be the result of the difference in size of the chromosomes The whole subject requires fuller investigation, which might yield significant results

DIŒCISM IN THE GARDEN ASPARAGUS —A paper on the degree of diœcism in the garden asparagus by T Shoji and T Nakamura, in the *Japanese Journal of Botany* (4, 125 152, 1928), raises many points of general interest In male plants the pistil was developed in the flowers to an extent that varied with the individual plant, but was very constant in the flowers upon any one plant In the male flowers, instead of the typical trilocular ovary, bi or unilocular ovaries may be found, and in some cases one carpel is modified into an anther An interesting test is made of Robinsohn's reagent for determining the receptivity of the stigmatic surface for pollen, by the extent to which it stains when immersed in a aqueous solution of sodium potassium tartrate and silver nitrate According to Robinsohn, the stigma should only stain deeply when it is in a receptive state, and tests of the normal pistils of asparagus were in accordance with this statement On the other hand, heavy staining of certain regions of the imperfect pistils in the male flowers, which were quite without stigmas, rendered the reagent useless in distinguishing between fertile and infertile carpels Wounds at the surface of the carpels tended to take up the stain, and the authors raise the question as to whether the degree of staining with this reagent is connected with the extent to which the cuticle is interrupted at the stigmatic surface, itself a question of some general interest Many details of the cytology of the degenerating mega and micro sporangia are given in this paper

LAND SHELLS FROM THE WEST INDIES —Dr H A Pilsbry and E G Vanatta describe three new land shells from Tortuga Island and one from Haiti, whilst Dr Pilsbry appends a paper on the species of *Lucidella* (subgen *Pœniella*), including two new, from Haiti and Santo Domingo (*Proc Acad Nat Sci Philad*, vol 80) Figures illustrating both papers are combined on one plate Fig 17, which is stated to represent a form of *Cerion tortuga*, n sp, differs so much from Fig 15, the type, and Fig 16, a coloration variety, as to suggest that, variable as these shells are, an illustration of some other species has accidentally been substituted when making up the plate

CARBONIFEROUS BRACHIOPODS —The first part of a monograph on British Carboniferous brachiopods, by the late Dr Ivor Thomas, was published in 1914 The second part (*Mem Geol Surv Gt Britain, Palæont*, vol 3, pt 1, pp 1 217, plates i xii, 1928) is the work of Miss H M Muir Wood and deals with the *semireticulatus* and *longispinus* groups of *Productus* (*sensu stricto*), of which 41 species or varieties are described The Producti can be divided into at least eight genera, namely, *Productus* (restricted), *Avonia*, *Buxtonia*, *Pustula*, *Overtonia*, *Sinuatella* (gen nov), *Proboscidella*, and *Etheridgina*, they include the largest brachiopod known, *Productus giganteus*, with a breadth of 300 mm The shell of *Productus* was apparently anchored by means of spines, sometimes five or six inches long, which are developed on the larger valve The Producti are very abundant in the Carboniferous, but afterwards diminished in numbers and became extinct at the close of the Permian period The group is said to have been derived from a Strophomenid ancestor in the Ordovician or Silurian The earliest British representatives are found in the Pilton Beds of North Devon (Upper Devonian or basal Carboniferous) Shells of the *semireticulatus* group make their appearance in the Zaphrentis zone and evolved rapidly, but during *Seminula* times conditions were unfavourable to the development of this group A multitude of new forms appeared in *Dibunophyllum* times and includes some over specialised species with a very limited range in time and space The sudden disappearance and extinction of the Producti is thought to be due in part to the excessive secretion of carbonate of lime

THE SHAP GRANITE —An important contribution to the petrology of the well known Shap Granite has been made by Dr D R Grantham, with the collaboration of Dr H F Harwood, who has made seven excellent analyses The results appear in the *Proc Geol Assoc*, pp 299 331, 1928 The 'granite' is a composite intrusion made up of a suite of porphyritic biotite granites allied to adamellite The oldest solid product of the original magma appears to be a chilled peripheral facies of basic type and probably hybrid origin This 'early basic granite' was disrupted by the ascent of the main intrusions, distinguished as Stages I and II, within which it occurs as the inclusions hitherto regarded as 'basic segregations' The main mass of the granite shows successive increase in porphyritic felspars and decrease in accessories A fourth phase is represented by Stage III, dyke like masses of granite still richer in phenocrysts The inclusions in Stage II comprise not only 'early basic' and Stage I types, but also numerous blocks of hornfelsed andesites and (rarely) Coniston limestone Evidence is brought forward to show that contamination of the original magma by reaction with, and assimilation of, the andesites of the country rock is beyond reasonable doubt Dr Harwood's analyses give practically a straight line diagram from 'andesitic inclusions' to Stage II, and this alone is weighty evidence in favour of assimilation Further joint work on the andesites themselves is in progress

SOUNDING AT SEA —The December issue of the *Journal of the Franklin Institute* contains an account of the methods used by the United States Coast and Geodetic Survey for the measurement of the depth of sea water, by Lieutenant J H Service, of the Survey Department For soundings in water too deep for the hand line the sound wave method in the form known as the 'fathometer' is most used An electrically driven oscillator strikes a diaphragm under water outside the ship and the sound reflected from the bottom of the sea affects a microphone in a water tank inside the ship's plating below water level In

series with the microphone is a neon tube which lights up when the reflected sound arrives at the microphone The tube is placed behind a radial slit in a revolving disc in front of which is a circular dial marked in fathoms The oscillator acts as the neon tube passes the zero of this scale, so that the depth is read at the end of the revolving slit when it flashes out red owing to the lighting up of the neon tube behind it The speed of sound in sea water of salinity 35 parts per 1000 at the surface and at 0° C is taken as 1450 metres per second It increases 4 metres per second per degree rise of temperature, 3 per 100 fathoms depth, and 1 per part per 1000 increase of salinity

STRONG ELECTROLYTES —The revival of interest in the properties of strong electrolytes which followed the publication of the Debye Hückel theory in 1923 shows no signs of falling off, and a further group of papers on this subject has appeared in the issue of the *Physikalische Zeitschrift* for Nov 1 One of these, by M Wien, on departures from Ohm's law, is of particular importance An electrolyte has been shown to undergo a decrease in resistance when it is subjected to high electric stress In relatively weak fields the increase in conductivity is approximately proportional to the square of the field strength , for larger fields, the rate of increase is linear and finally, when an intensity of the order of a hundred kilovolts per centimetre has been attained, a new value of the conductivity is reached, which is several per cent above that for weak fields, and is practically unchanged by any further increase in the applied potential These effects depend in a characteristic way upon the valencies of the ions in the solution, and the ultimate value of the conductivity corresponds, within the limits of experimental error, with the conductivity of the same electrolyte in a weak field at infinite dilution These observations, together with some others made by M Wien on the effects of alternating fields on electrolytes, have been discussed by G Joos, and have been shown to be at least in qualitative accord with the newer versions of the Debye Huckel theory

LUMINESCENCE —A report upon cathodo luminescence and the luminescence of incandescent solids by E L Nichols, H L Howes, and D T Wilber, that has been issued as a *Publication of the Carnegie Institution of Washington* (No 384), furnishes a valuable summary of the experimental work that has been carried out by the authors and others in this little known branch of optics Their object has been to bring together investigations on the relations between the emission of light from hot bodies, other than purely thermal radiation, and such phenomena as fluorescence and phosphorescence at lower temperatures Some of their results are very surprising, for example, the frequent excess of the radiation over that from a black body at the same temperature, and in general they find that selective emission, when excited thermally, shows the effects characteristic of ordinary fluorescence The position of the bands in the spectra is often, moreover, the same under the different modes of excitation, of which exposure to a hydrogen flame and to the light of an iron arc are two typical examples, and from the evidence that they have presented they conclude finally "that the luminescence superposed upon the incandescence of the various solids is simply a *fluorescence* in all essentials identical with that commonly excited by light, cathode rays and other familiar agencies "

A MULTIPLE DOME ARCH DAM —A reinforced concrete dam of unusual design has recently been completed in a canyon of the Gila River, Arizona, U.S A The dam is for a reservoir for the storage of water for flood control and power supply and for the irrigation of some 100,000 acres of land held as a reservation for the settlement of certain Indian tribes The dam is the subject of a well illustrated article in the *Engineer* for Jan 18, from which it will be seen that not only is it of unique design but it is also a handsome structure Many single arch and multiple arch dams have been constructed, and in these inclined arches spring from the piers, each arch sustaining the vertical weight of water as well as its horizontal pressure In the new Coolidge Dam, as it is called, these arches are replaced by dome shaped structures something of the form of the half of a very thick eggshell cut along its major axis In the Coolidge Dam there are four piers, 180 feet centre to centre, and from these spring three ferro concrete domes which are 21 feet thick at the base and 4 feet thick at the crown The height of the dam is 250 feet The first of its kind, the dam was designed by Major C R Olberg, of the United States Indian Bureau, and in his description of it he states that the maximum compression stresses for the dome were fixed at 600 lb per sq in , and in the buttresses at 400 lb per sq in At first sight the shuttering for the construction of such domes would appear to be a matter of great difficulty, and not the least interesting feature of the work was the method used by the contractors for this shuttering

NITRALLOY STEELS —The issue of the *Chemical Age* for Jan 5 contains some interesting information concerning the case hardening of steels by nitrogen When iron and steel are heated in an atmosphere of ammonia nitrogen is absorbed, and with special steels (nitralloy) a very hard surface is produced The 'nitration' is carried out after machine finishing, since no deformation occurs, providing that all strains have been relieved by suitable heat treatment, but only a small regular swelling, for which due allowance can be made The resulting hardness is 900 1100 on the Brinell scale (chromium vanadium steel, case hardened, being 742) and permits glass and quartz to be cut The nitrated steels are capable of taking a mirror finish, and it is claimed that they show exceptional resistance to wear They retain their hardness up to 500° C

OXIDATION OF PYRITES IN COAL SEAMS —The Safety in Mines Research Board has issued a report of an investigation by H Macpherson, N Simpkin, and H Wild (S M R B Paper No 47 London H M Stationery Office , 1*s* 6*d*) recording an examination of the occurrence of pyrites and its oxidation by air, particularly in the Ravine seam of Lancashire Their work supports the view that pyrites acts not so much by initiating combustion as by promoting disintegration of the massive coal This disintegration is brought about by the volume change on oxidation and assists access of air to the coal substance itself, which can then take up oxygen and so become heated

FIRING COAL DUST —A paper, by T N Mason and R V Wheeler, issued by the Safety in Mines Research Board (S M R B Paper No 48 H M Stationery Office 3*d*), records experiments on firing coal dusts in a steel gallery, 7½ feet in diameter The results confirm the view that the inflammability of the dust increases with the content of volatile matter of the coal, inflammability being measured by the mean speed of the flame Explosability—measured by the maximum pressure developed—is of the same order and in close agreement with the proportion of incombustible matter which must be mixed with the coal dust to suppress its inflammability

High Pressure Gas Research

AT the invitation of the governing body and the rector of the Imperial College of Science and Technology, a distinguished company assembled at the College on Jan 21 to inspect the new equipment of the high pressure gas research laboratories and the work in other sections of the Department of Chemical Technology An opportunity was thus afforded of observing the results of a consistent policy of fundamental research, conducted in the atmosphere of intellectual freedom traditionally associated with British universities, into matters which from their very nature form the prop and stay of important sections of the industrial structure The Department, which was inaugurated in 1912 under the direction of Prof W A Bone, now comprises three sections (1) fuel technology with refractory materials, combustion, and high pressure gas reactions and explosions, retained by Prof Bone under his immediate personal supervision, (2) chemical engineering in the charge of Prof J W Hinchley, and (3) electrochemistry, superintended by Assistant Prof G I Finch The breadth of its scope and aims has remained unchanged since its inception, the recent establishment of a special chair in chemical engineering being a natural consequence of the increasing size and influence of the department

The work of the Department is exclusively of a post graduate and research character, being chiefly directed to giving graduates in chemistry from the Imperial College or elsewhere a broad and practical training on fundamental lines, a training calculated to combine true intellectual development with an acquisition of the knowledge and skill required of holders of responsible positions in industry In addition to the professorial staff there are three lecturers and an instructional assistant, whilst the personnel of the fine modern workshop consists of four skilled mechanics The students (excluding sundry occasional students) at present number 25, and there are 18 paid research assistants and fellows The cost of the Department, in which there are thus 50 people continually prosecuting scientific and technological studies, amounts to about £13,000 per annum of which about £7000 is defrayed out of the ordinary College funds the remainder being in the form of aids and grants from various extra mural sources Of more than 150 post graduate students who have already passed through the Department—some hailing from Australia, Canada India, South Africa the United States of America, China, or Japan—most now occupy responsible posts as fuel technologists, plant managers, chemical engineers, or research chemists in industrial concerns

FIG 1—Gas holders and the 1000 atm 5 stage compressor

FIG 2—An explosion bomb with filling and optical recording systems

The successful growth and operation of the Department has been achieved in buildings which, even after sixteen years, are far from complete The first two stories (providing for fuel technology and in part for chemical engineering) were erected in 1913–14, after the War two further stories (for chemical engineering and electrochemistry) were added, but the continuous growth of the Department, and more especially its research developments, have rendered the present accommodation quite inadequate for the increasing needs of its work and activities A scheme for the further enlargement of the building has therefore been approved, and will be carried out as soon as the necessary funds are forthcoming The capital

expenditure on buildings and equipment to date has been approximately £60,000, and about £50,000 more is required for the extension now contemplated

Fig 3 —Bomb which withstands explosion pressures up to 15 000 atm with filling system mirror for reading gauges and safety curtain

It has been the constant policy of the Department to base its activities on a bedrock of fundamental research, and it now has a highly trained staff of research assistants who organised in groups, prosecute systematic lines of research which are carefully planned in advance After two terms, the student is attached for about a year to one of these groups, afterwards being allowed to proceed independently or to become a group leader, he is thus disciplined in technique and accuracy, and he learns the value of co operation and the benefit of leadership, whilst at the same time a continuity of skilled workers over a period of years is assured Each of these men is, of course, supported by extra mural grants or aids, and the leader, on passing out into the industrial world, immediately occupies the post which is awaiting him During his period of leadership he has added to his scientific qualifications valuable experience in the control of technical men, in the preparation of weekly reports of progress, and in the discussion of his own and cognate researches at frequent and regular intervals, both with Prof Bone and with his fellow group leaders and researchers It may be of interest to give a brief account of the principal lines of fundamental work which are being actively pursued in the Depart ment

Chemistry of Coal

The group investigating, with the aid of grants from the Fuel Research Board and a fellowship maintained by the Sensible Heat Distillation Co, the chemistry of coal has already examined brown coals, lignites, bituminous, semi bituminous, and anthracitic coals from all parts of the world It has devised means for the extraction, by benzene at 250°, of the primary oils and the coking constituents of coals, this operation is naturally conducted in a separate fireproof shed Much light has been thrown on the chemical aspects of the maturing of coals, and it has been found possible to oxidise the residue after extraction to about 40 per cent of its weight of benzenecarboxylic acids

Gaseous Combustion and Reactions at High Pressures

The work on mixtures of air with carbon monoxide, hydrogen, or methane at initial pressures up to 200 atm—itself of a pioneering nature—is, with the assistance of grants from the Department of Scientific and Industrial Research, Imperial Chemical Industries, Ltd, and the Gas Light and Coke Co, Ltd, being extended to initial pressures of 1000 atm A single pre paration of the pure gas affords 10 cub ft, which is purified, collected in one of a series of small, dis tinctively coloured gas holders, and then compressed in five stages up to 1000 atm (Fig 1), it is then stored in boldly painted cylinders — red (hydrogen), brown (methane), black (air), green (carbon monoxide), or yellow (helium), of 60 cub ft of the latter obtained from America four years ago 35 cub ft remain Every cylinder is numbered and records are kept of its use, one person is in charge of them, whether filled at 1000, 400, or 200 atm, and analyses each fresh charge The

Fig 4 —Multiple unit high pressure catalytic circulating system.

most stringent rules guard, so far as is humanly possible, against accidents Incidentally, the absence of exact data requires that compressibility measure-

ments be made on every gas mixture employed There are three bombs for experiments employing up to 200 atm initial pressure (Fig 2)—the old bomb used by Prof Bone at Leeds, a spherical bomb, and a cylindrical bomb with quartz windows for spectro graphic work—and one, having 9 in walls, wire wound, and protected by thick rope curtains (the best known device), for experiments at initial pressures up to 1000 atm (Fig 3) This bomb is charged by a one stage process with gas, and then by a two stage process with air, in order to attain the requisite pressure, the charging is controlled from a distance, and the gauges are observed in a mirror All the large apparatus, with the exception of the new 1000 atm compressor, the compressor for catalytic experiments, and a few cylinders, which were made in Germany (from designs which, like those of most of the apparatus, were prepared by Dr D M Newitt in consultation with Prof Bone), are of British manufacture Another new apparatus, with quartz windows, maintains steady continuous flames at pressures up to 100 atm Experiments on the catalytic production of methyl alcohol in a single tube unit will be extended with a new plant having three vertical catalytic tubes operated under 1000 atm pressure at 600° C (Fig 4)

Photographic Study of the Development of Gaseous Explosions

Supported by Nobel's Explosives Co, Ltd, this work has included the investigation of phenomena associated with the initial stages of gaseous explosions, and the influence of 'shock waves' in speeding up combustion and developing detonation, and it is now being ex tended to that of the influence of strong electrical and magnetic fields on flame propagation in gaseous explosions A novel form of camera designed by Mr R P Fraser, and constructed for these researches, attains a film speed of 200 metres per sec A similar camera has been sent to Messrs Nobel's at Ardeer, and another is to be despatched to the Australian Govern ment

Combustion of Carbon Monoxide, etc

With the aid of fellowships maintained by the Gas Light and Coke Co and Radiation Ltd, the influence of moisture on the combustion of carbon monoxide has been shown to be essentially electronic The limit of drying capacity of phosphorus pentoxide on a mixture of carbon monoxide and oxygen is attained in about 200 days, but however carefully dried, the two gases always explode if a sufficiently powerful spark is employed

Blast Furnace Reactions

These investigations, which are being carried out under the auspices of the National Federation of Iron and Steel Manufacturers, aim at studying each re action fundamentally, and at the gas speeds—up to 20 m p h—actually obtaining in the blast furnace In particular, the phenomenon of carbon deposition, which occurs on interaction of ferrosoferric oxide and carbon monoxide, and at 450° by the change $2CO = C + CO_2$, but not above 650°, is being followed up with the view, broadly speaking, of discovering whether or not the deposition should be encouraged, and what factors influence its appearance Such knowledge is a positively essential preliminary to any marked chemical advance in the manufacture of iron, and the results will be of great value in the characterisa tion of ores To acquire them is costing some £1600 per annum

Surface Action and Ionisation

Gaseous combustion in electrical discharges, and the electrical condition of surfaces during catalytic combustion, are under investigation Work sup ported by the Department of Scientific and Industrial Research, and directed by Asst Prof Finch, has already shown that combustion is conditioned by a prior 'ionisation' of both the combustible gas and oxygen

Chemical Engineering

Prof Hinchley's section of the Department, in addition to providing systematic post graduate instruction in the operation of chemical plant—instruction in which special attention is given to costing and to the actual construction of suitable units—is, with the support of the Distillers' Company, engaged in investigating fundamental problems con nected with heat transmission and filtration As soon as space is available, and further equipment installed, it will be possible to attack more adequately and systematically from a fundamental point of view the many problems encountered in the design and operation of chemical plant

The Henri Poincaré Institute in Paris.

IN November last a new institute of mathematics and mathematical physics was formally inaugurated in Paris It was both the official opening of a new building and the beginning of new courses of lectures, all to be a part of the Faculty of Sciences of the Uni versity of Paris The building is now ready, but the internal arrangements are not yet complete

The history of the new institute is brief It had been noted by the International Education Board that on several occasions it had given large sums of money to different universities in Europe and that gifts to French universities had been on a much smaller scale The importance of the French mathematical school suggested that help might usefully be given to mathe matics in France The decision was taken after consultations in which Prof Trowbridge, who repre sented the International Education Board, and Prof Birkhoff took leading parts Prof Émile Borel was asked to draw up a scheme The plan, which was approved, provided for an institute to be named 'L'Institut Henri Poincaré,' as a centre for teaching and research on mathematical physics and the calculus of probabilities

The courses on physical theories will be given in the new Institute by Prof Léon Brillouin and M Louis de Broglie Prof Léon Brillouin has made himself known by his researches on the theory of quanta and its applications, and he was invited last year to lecture in several universities of the United States and Canada Dr Louis de Broglie is one of the creators of wave mechanics, which now play a leading part in mathematical physics These courses form an important addition to those already given in Paris by Prof Brillouin and Prof Langevin at the College de France, and by Prof Eugène Bloch and Prof Villat at the Sorbonne

The calculus of probabilities already has its great exponent at the Sorbonne in Prof Émile Borel His researches on this subject have done much to revive interest in France in this subject, which owes so much to French workers such as Pascal, Fermat, Laplace, Poisson, Bienaymé, Cauchy, Cournot, Ber trand, Henri Poincaré To Prof Borel's course will now be added a new course by Maurice Fréchet, formerly professor of higher analysis at the Uni versity of Strasbourg His theory of abstract spaces and functions has already made him known in the United States, where he delivered a course of lectures

at the University of Chicago in 1924 More recently, he has devoted much attention to the theory of probability, on which he has published (in collaboration with Prof Halbwachs) "Le calcul des probabilités à la portée de tous"

The Henri Poincaré Institute will not, however, confine its attention to the new courses It aims at being international in scope, in addition to the regular courses, single lectures or brief series of lectures will be given by distinguished scientific workers Profs Vito Volterra, of Rome, and de Donder, of Brussels, have already promised to co operate

The ever increasing numbers at the Sorbonne has made additional accommodation necessary, and it was decided to erect a new building where not only the new courses but also all the advanced courses on mathematics will be given and where the mathematical library will be moved The International Education Board is contributing one hundred thousand dollars towards these expenses, Baron Edmond de Rothschild has also contributed twenty five thousand dollars, and the French Ministry for Education three hundred thousand francs It is thus hoped to create in Paris a great scientific international centre for mathematical physics and calculus of probabilities

Development and Morphology of Tunicates

A RECENT issue of the *Quarterly Journal of Microscopical Science* (vol 72, pt 1) is entirely occupied by two memoirs on Tunicata In the first, on the development of *Botrylloides* and its bearings on some morphological problems, by Miss Sylvia Garstang and Prof Walter Garstang, uniformity in the purely ectodermal origin of the Ascidian atrium is established which finally negatives the homology suggested by Van Beneden and Julin (1887) between the larval atrial canals of Ascidians and the spiracles of Appendicularians

The investigation of the neuro hypophysial system shows that the anterior part of the neural tube in front of the sensory vesicle undergoes a conspicuous development, and becomes longitudinally differentiated into two parts—a large ventral precerebral lobe which disappears entirely before the tadpole stage is reached, and a slender dorsal precerebral duct which persists and agrees essentially with the hypophysial duct of other Ascidians This duct communicates with the oral region of the pharynx by a ciliated funnel, and gives rise to the brain by proliferation from its ventral wall

It would appear that a considerable development of the pre sensory region of the neural canal and its glandular modification was a primitive feature of the Tunicata, and distinguished them from *Amphioxus* and the Vertebrata The comparative morphology and significance of the precerebral lobe is fully discussed

The second paper is by Prof Garstang alone It is an interesting and speculative essay on the morphology of the Tunicata and its bearings on the phylogeny of the Chordata He regards the current views of Tunicate ancestry—that the tailed larva represents the primitive or ancestral form from which the adult has been evolved by degeneration—as untenable The neuro muscular relations in Ascidian larvæ and Appendicularians are much more consistent with a theory of incipient than of vestigial metamerism and the development of atria before the gill slits is in accordance with the phyletic history of the Protochordate type of gill slit The discontinuity between larval and adult nervous systems ("it is an error to assert that any part of the actual nervous system of the adult has formed a part of the larval nervous system") in Tunicates is unintelligible on the theory that Tunicates have been derived from *Amphioxus* like ancestors, and points to a derivation of Tunicates from ancestors with a metamorphic life history before the typical chordate nerve tube had come into existence

The author has re studied the symmetry of *Amphioxus*, which he explains as the consequence of the secondary reduction of yolk in the egg entailing premature hatching and the improvisation of a larval feeding mechanism A great enlargement of the mouth and special ciliation of its entrance seem to form the basis of this mechanism, which involves a temporary dislocation of the adjacent parts and is held to have entailed changes which have left a mark on the permanent organisation of the adult The author concludes that the ancestors of *Amphioxus* were essentially primitive Ascidians In a future communication he proposes to deal with the origin of the chordate nervous system and with the various cephalic organs associated with it

University and Educational Intelligence

LONDON —The Senate has accepted an offer of the Committee of the Bayliss Starling Memorial Fund of the sum of £2500 for the establishment at University College of a scholarship for training in physiology and biochemistry to commemorate the connexion with physiology of the late Sir William Bayliss and Prof E H Starling

The following doctorates have been conferred D Sc (in anatomy) on Mr H A Harris (University College) for a thesis in the form of a series of memoirs dealing with the problems of bone growth, radiology, and teratology, published in various medical and scientific journals, D Sc (in botany) on Mr W B Turrill (Chelsea Polytechnic), for a thesis entitled "The Phytogeography of the Balkan Peninsula", D Sc (in chemistry) on Mr Edgar Stedman (Birkbeck and Goldsmiths' Colleges) for a thesis entitled "The Relationship between Chemical Constitution and Physiological Action", D Sc (in psychology) on Mr J C Flugel (University College), for a thesis entitled "Studies in Mental Oscillation and Related Functions"

Dr A Sterling Parkes has been awarded the William Julius Mickle Fellowship for 1929 in respect of the work he has carried out during the past five years on the physiology and biochemistry of the organs of reproduction The Fellowship this year is of the value of about £250

Dr G P Crowden has been appointed lecturer in applied physiology in the Division of Public Health at the London School of Hygiene and Tropical Medicine as from Aug 1

In March last a committee was appointed "To consider the question of the limitations placed upon the Medical Education of Women Undergraduates and to report to the Senate thereon" This report has now been issued The problem was to provide clinical facilities for women requiring them in schools open to both sexes The report points out that the prepossession of the University is in favour of co-education in medicine as in all other faculties, and suggests that there should be three types of clinical education (1) for men only, (2) for women only, and (3) for men and women The Senate has given general approval to the report, and schools of medicine not at present admitting women are to be invited to admit a quota of women students

THE annual meeting of the Association of Technical Institutions will be held at the Grocers' Hall, London,

on Friday and Saturday, Feb 22 and 23, under the presidency of the Right Hon Lord Melchett The programme includes papers by Sir Gerald Bellhouse, H M Chief Inspector of Factories, on industrial safety, by Mr C A Siepmann, of the British Broadcasting Corporation, on broadcasting and its relation to technical education, and by Miss E E Cox, Principal, L C C Barrett Street Trade School, London, on technical training for women The Lord Mayor of London will entertain members and guests of the Association to luncheon on Feb 22 at the Mansion House

THE Commonwealth Council for Scientific and Industrial Research recently directed the attention of the Australian universities to the paucity of suitable candidates for the senior studentships in biological sciences which are being provided from the Science and Industry Endowment Fund These studentships, if held abroad, are of the value (including fares) of £425 per annum for two years, and candidates are required to have given some evidence of capacity for original research work To stimulate interest, it is now proposed to make available a number of junior studentships tenable either in the Council's laboratories or in Australian universities They will be awarded to young graduates who have completed satisfactory courses but have not yet had sufficient opportunity to demonstrate their capacities for original work At the end of their tenure the holders may become eligible for senior studentships abroad, or may perhaps be appointed to junior positions in one or other of the Council's research divisions

"EDUCATION for Industry and Commerce" (H M Stationery Office, 6d net) is the title of a pamphlet recently issued by the Board of Education It is particularly timely in view of the reports of committees which, during the past three or four years, have touched upon the impact of scientific research and industrial development upon our educational theories Already, arising out of those reports, Lord Eustace Percy has instituted two specific inquiries (salesmanship and engineering), and the present pamphlet, a survey of the arrangements at present in force for securing co operation between technical schools and industries, is intended as an introduction to the new series of inquiries which are to be made into the organisation and methods of technical education The pamphlet contains a preface by Lord Eustace Percy, which is an amplification of the detailed reply he made to the Emmott committee of inquiry into technical education and industry It is a detailed view of the present educational facilities, but it is no mere tabulation Especially worthy of attention are the passages dealing with the origin and purpose of our existing secondary schools Referring to the Emmott committee's suggestion (which came from industry) that a memorandum should be prepared by the Board "covering the main features required in any technical training," the preface clears up one or two possible misunderstandings, but we still hope that such a memorandum will be issued, for without some national lead many employers find themselves in not a little difficulty The arrangements for co operation between industry and technical education are described in their two broad divisions—local arrangements under a local education authority, and the wider forms of co operation on a national or regional basis Developments since the War, such as the formation of joint industrial councils and research committees, are shown, as is also a useful list of places which have established advisory committees in specific subjects

Calendar of Patent Records

February 5, 1863 —The optical illusion known as 'Pepper's Ghost,' in which the images of living people could be projected on to the stage at will, and which proved an attraction at the Royal Polytechnic Institution for many years, was patented by Henry Dircks and J H Pepper on Feb 5, 1863

February 6, 1855 —The first 'artificial silk' patent was granted in England to George Audemars of Lausanne on Feb 6, 1855 Audemars dissolved nitro cellulose in an alcohol and ether mixture, and drew out threads from the solution by means of a steel pointer, the thread could be worked in the same way as silk and could be used as a substitute for it It was not, however, until after many years of experiment and research that commercial success for the new thread was achieved by Chardonnet, the real pioneer of the vast industry of to day

February 7, 1589 —The art of papermaking reached Great Britain comparatively late Down to nearly the end of the sixteenth century, our old linen cloths and rags were bought up by foreigners and all the best paper was imported from abroad A very successful paper mill was, however, set up by 1588 near Dartford, in Kent, by John Spilman, one of Queen Elizabeth's jewellers, who brought over workmen from Germany and was granted a patent for ten years on Feb 7, 1589, to make white writing paper The patent was renewed in 1597 for fourteen years and extended to cover all kinds of paper, and the mill continued to work under different owners until well into the eighteenth century Spilman was knighted by James I in 1605, on the occasion of the King's visit to his works

February 8, 1827 The achievement of perpetual motion has been the aim of a multitude of inventors from Wilars de Honicort in the thirteenth century down to the present day and some hundreds of patents for more or less ingenious machines have been applied for and granted in England One of the most interesting of these was granted to Sir William Congreve, of rocket fame, on Feb 8, 1827 An endless band of sponge runs round three rollers arranged in a frame at the angles of a right angled triangle, and has attached to it on its outside an endless chain of weights so that the two bands move together—the parts of the chain and band being so uniform in weight that when the frame is placed with the hypotenuse upwards and the shorter side vertical, the system is in exact equilibrium In this position the frame is placed in water with the lower part and two rollers immersed The water is absorbed by the sponge on the vertical arm of the band because on that side it is not compressed by the weights, and the water will rise above its level and create a load that will set the band in motion

February 8, 1841 —On Feb 8, 1841, a patent was granted to W H Fox Talbot for his 'calotype' process of photography This was the first process in which both a negative and positive were employed, and in which, therefore, a number of prints could be obtained from the one sitting Talbot's process was cheaper than Daguerre's, which had been patented in Great Britain two years earlier, but did not give such clear impressions and was not very extensively used

February 8, 1898 —Aspirin was put on the market as a drug by the German firm Fr Bayer, which applied for a German patent on Feb 8, 1898 The grant was, however, successfully opposed and no patent was actually issued A corresponding English patent was granted in December 1898

Societies and Academies.

London

Royal Society, Jan 24.—D Denny-Brown (1) On the nature of postural reflexes Postural reflexes are all based on Liddell and Sherrington's stretch reflex This basic reflex is a discharge of motor impulses at a slow rate, and no mechanical plastic or fixing mechanism is involved, except contraction caused by those impulses The magnitude of reflex response changes by alteration of number of nerve units in discharge This is effected by variations in excitation of units, either from changes in tension on muscle or from changes in excitatory effect relayed from higher levels of nervous system —(2) The histological features of striped muscle in relation to its functional activity Speed of contraction is a property of muscle fibres independent of observable histological differences, although development of rapid contraction occurs in fibre groups which are more highly differentiated for storage of lipoid substances or factors increasing fibre diameter —**W S Stiles** The effect of glare on the brightness difference threshold A method is described for determining brightness difference threshold in presence of point source of glare The value, for two subjects, of Fechner's fraction in absence of glare has been found for field brightness 0 001–2 2 candles/sq ft Threshold in presence of glare source is best expressed in terms of equivalent background brightness and a formula is developed which serves over this range —**L J Harris** The combination of proteins, amino acids, etc, with acids and alkalis Part 2 Titration curves of amino acids, in presence of formol Curves are given for variation in pH value (colorimetrical) with amount of soda added when amino acids are titrated in aqueous formaldehyde, each addition being corrected for the acidity of the 'solvent' The hydrochloric acid titration curve remained virtually unchanged by addition of formaldehyde The results are explained on the basis of the 'zwitterion' hypothesis, according to which the caustic soda and hydrochloric acid titrations relate not to the apparent, but to the *true*, basic and acidic constants —**F W R Brambell and G F Marrian** Sex reversal in a pigeon (*Columba livia*) —**J B Gatenby and Sylvia Wigoder** (1) The effect of X radiation on the spermatogenesis of the guinea pig X radiation prevents mitosis in those cells entering prophase It is suggested that the X radiation breaks up lipoids in some way essential to mitosis Mild doses cause only temporary interference with lipoid metabolism, so that cells not already entering prophase of mitosis are able to recover No evidence of stimulation effects by X rays was procured —(2) The post nuclear body in the spermatogenesis of *Cavia cobaya* and other animals In probably all flagellate sperms, the flagellum is fixed to the nucleus, not by the head centrosome, or by a protoplasmic membrane, but by a special structure called the post nuclear body This has often been mistaken for centrosome, middle piece, or acrosome It is a separate and distinct structure which (especially in molluscs) can be traced back into the spermatocyte —**J B Gatenby** Study of Golgi apparatus and vacuolar system of *Cavia*, *Helix*, and *Abraxas*, by intra vital methods —**A B Macallum** Ionic mobility as a factor in influencing the distribution of potassium in living matter

Dublin

Royal Dublin Society, Dec 18.—**W R G Atkins and H H Poole** The integration of light by photo-electrolysis A vacuum sodium photoelectric cell of the Burt type was used It was found possible to detect the production of alkali within ten seconds in daylight The action of light may be integrated by titrating the alkali produced by a standardised cell The deposition of copper appears preferable for longer periods, about 0 13 mgm being deposited in a winter day, the potassium ethyl xanthate method serves for the estimation of the copper

Edinburgh

Royal Society, Jan 7.—**H S Allen** Remarks on band spectra A review of recent progress in the interpretation of band spectra It is now known that band spectra originate in molecules containing more than one atom Emphasis is laid on the close similarity between the electronic levels of molecules and those of 'corresponding' atoms, *i e* atoms with the same number of outer electrons The application of the new quantum mechanics has removed outstanding difficulties as regards quantum numbers in band spectra —**Ian Sandeman** The Fulcher bands of hydrogen An examination of Richardson's arrangement of these bands in the light of recent accurate measurements of the hydrogen spectrum by Gale, Monk, and Leo, while strongly confirming Richardson's allocation of the Q branches, has failed to yield confirmation of the remaining branches which he gives A number of new combination relations holding between the lines of the Fulcher bands are given These indicate that there are three main branches in each band, designated the R', Q, and P' branches, the Q branch being identical with that of Richardson The R' and P' branches have a common initial level differing from that of the Q branch, while all three branches have a common final level —**F B Hutt** (1) On the relation of fertility to the amount of testicular material and density of sperm suspension in the fowl Fertility in the male and the number of spermatozoa per cubic centimetre of semen are not determined by the amount of testicular material present In cases of unilateral castration in which testis grafts had been implanted, the remaining testis did not undergo hypertrophy —(2) The frequencies of various malpositions of the chick embryo and their significance Of 39,760 eggs incubated, 11,797 which failed to hatch were examined Of these, 5050 contained embryos that had died after the eighteenth day of incubation In 56 per cent of these cases the chick had assumed an abnormal position within the shell, and this malposition was responsible for death The malpositions seem to follow upon an incorrect orientation established by the first few cleavage divisions —**F B Hutt and A W Greenwood** (1) Chondrodystrophy in the chick Among 7135 embryos of nine days or older found dead in the shell, 112 cases of chondrodystrophy were encountered From 1900 eggs incubated, 124 chondrodystrophic embryos were obtained The condition is greater in January and February, and thereafter declines to an almost complete absence in June It is hereditary and expressed under certain unfavourable environmental conditions, such as lack of direct sunlight —(2) Chick monsters in relation to embryonic mortality Among the 11,797 dead-in shell examined, 433 monsters were encountered Hyperencephaly, exencephaly, and microphthalmia provided 93 per cent of these Both sexes were equally affected The incidence of these monsters was highest in February and thereafter declined Chilling of the egg in the early stage of gastrulation seems to be a cause of arrested development observed —**L A Harvey** The oogenesis of *Carcinus mænas* Penn, with special reference to yolk formation Observations on yolk-formation in *Carcinus mænas* support the idea that yolk is formed not by the solitary action of the

various components of the cell, as has for a long time been considered to be the case, but by the interaction of the majority of the constituents of the egg Probably the extent to which the different elements participate varies in different families, orders, etc, but fundamentally the same method of yolk formation is present in all animals, as would be expected on an evolutionary theory —**John Wishart** The correlation between product moments of any order in samples from a normal population A new method of determining sample moments exactly in semi invariant form up to any desired order and from any population the moments of which are known, is applied to the particular case of a normal population, and the correlation between all product semi invariants of the same order in two varieties is reached

PARIS

Academy of Sciences, Jan 2—**H Deslandres** Simple relations between the most intense and the highest radiations of the chemical elements in the bright atmosphere of the sun —**L Léger** A mycetogon pseudo tumour of alimentary origin causing an obstruction in the stomach of the trout The pseudo tumour was found to consist of a mass of undigested material covered with a growth of the fungus *Ichthyphonus intestinalis* —**Paul Delens** The calculus of spherical operations —**Marcel Vasseur** Deformable surfaces with a persistent conjugated conical network —**Nicolas Cioranesco** The problem of Dirichlet for systems of partial differential equations of the second order —**J Delsarte** Oblique co ordinated systems in functional space —**T Bonnesen** Linear approximations —**Georges Calugaréano** The determination of the exceptional values of integral and meromorph functions of finite order —**N Podtiaguine** Regular functions of higher order than two —**S B Nicholson** and **Nicolas G Perrakis** The presence of the absorption line D_3 in the solar spectrum The atmospheric line A (5875 603) is so close to the D_3 line (5875 620) that it is possible that the two have been confused by earlier workers An account is given of observations, utilising the 43 cm telescope of the Mount Wilson Observatory, for which the dispersion of the first order spectrum is 1 mm = 0 72 A The atmospheric line makes visual observations uncertain, but definite results could be obtained from photographs, making use of a modified Koch microphotometer The dark line D_3 has only been observed in the regions covered with faculæ in the absence of visible spots —**R Swyngedauw** The variation of the velocity and of the tension of a pulley belt along the pulley —**Thadée Banachiewicz** The ellipticity of the terrestrial equator —**J Kampé de Feriet** A necessary condition for the absence of negative pressures in a perfect plane fluid in permanent movement round an obstacle —**Henri Villat** Concerning the sign of the pressures in a perfect fluid —**R Darbord** A mercury and oil manometer A description of a simple form of two fluid manometer, suitable for pressures over the range of a few millimetres to some centimetres of mercury and possessing fifteen times the sensibility of a plain mercury manometer —**R Audubert** and **Mlle M Quintin** The mechanism of the unsymmetrical conductivity of imperfect contacts The hypothesis of electronic emissions accompanied by ionisation phenomena leads to a qualitative and quantitative interpretation of the unsymmetrical conductivity of imperfect contacts of silicon, and probably also of the mechanism of the silver sulphide and lead sulphide detectors —**Jean Thibaud** Longitudinal magnetic actions on bundles of slow electrons (concentrations and periodic expansions) —**Marcel Cau** The double refraction and dichroism of thin layers of iron obtained by distillation —**Ch Bouhet** The elliptical polarisation produced by reflection at the surface of solutions of the fatty acids in water The results described, shown graphically for acetic, propionic, butyric, and valeric acids, agree with Langmuir's hypothesis The molecules of fatty acids are, for these solutions, arranged with the hydrocarbon chain placed perpendicularly to the surface of the liquid —**Pierre Daure** The secondary radiations observed in the molecular diffusion of light (Raman effect) Results of observations on solutions of the chlorides of antimony, bismuth, magnesium, and aluminium, calcium bromide, liquid ammonia, and liquid methane —**J Gilles** The structure of the third order spectrum of sulphur (S III) —**Mme Irène Curie** The measurement of the active deposit of radium by the penetrating γ radiation The fraction K of ionisation attributable to radium B, when radium B and C are in radioactive equilibrium, has been determined by Slater for varying thicknesses of lead These results are now confirmed by a totally different method, and Slater's curve can be used to apply the necessary correction in the measurement of radium C, made with respect to a radium standard —**P Fallot** The secondary of the subbetic massifs between Moratalla and the edge of the Betic zone —**Maurice Blumenthal** The tectonic relations between the Betic of Malaga and the Betic of Granada —**A Demay** The tectonic rôle of the granites and granulites of the western edge of the Sainte Etienne coal basin —**Louis Dangeard** Circles of large pebbles observed at Jan Hagen Island —**G Chalaud** The spermatozoid of *Cephalozia bicuspidata* —**F Obaton** The origin and evolution of mannitol in plants The study of the evolution of mannitol in two plants, *Sterigmatocystis nigra* and celery, proves that its function is that of a reserve substance, the alcohol appears to play the same part as saccharose and trehalose, but its formation is not in direct relation with the two latter substances —**R Combes** and **M Piney** Proteolysis and proteogenesis in ligneous plants at the commencement of the active period of growth —**Marc Simonet** New researches on the number of chromosomes in the hybrids of the garden iris (*Iris germanica*) —**Aug Chevalier** The degradation of tropical soils caused by bush fires and the regressive plant formations which are the consequence of it A discussion of the effects of bush fires, leading to production of soils either sterile or only capable of supporting certain useless plants —**Louis Semichon** The vesicular cells in *Anomia ephippium* —**Alphonse Labbé**, The pallial sensorial organs in *Rostanga coccinea* The dorsal part of the mantle of *Rostanga coccinea* is covered with small tubercles, hitherto described as simple conical papillæ These are, in reality, complex sensorial organs, of unknown function —**Remy Collin** The passage of hypophysial cells in the cephalorachidian liquid of the infundibular cavity —**Ch Pérez** Sexual characters in *Macropodia rostrata* —**Tchang-Yung-Tai** The localisation of intestinal absorption and the behaviour of the absorbent cells in the caterpillars of *Galleria mellonella* —**J Legendre** The competition between zoophile and anthropophile mosquitoes In an earlier paper an account was given of a race of mosquitoes avoiding man These replace the mosquitoes attacking man when both are in the same locality, and this biological method of fighting the mosquito attacking man is suggested as worthy of trial —**P Wintrebert** The digestion of the internal tubular envelope of the egg by ferments proceeding from the spermatozoids and the ovule in *Discoglossus pictus* —**P Reiss** and **E Vellinger** The potential of the arrest of egg-division in the sea urchin —**E. Gabritschevsky** Compensation and regeneration in *Thomisium onustum*. Phenomena

of reversion and of accelerated evolution of the tegumentary characters under the influence of regeneration —**Marcel Duval** The proportion of carbon dioxide in the blood of the snail, *Helix pomatia*, in the course of the annual cycle The amount of carbon dioxide is relatively slightly influenced by the state of activity of the animal —**R Fosse and Mlle V Bossuyt** The quantitative analysis and characterisation of allantoin The allantoin is hydrolysed, first in alkaline solution to potassium allantoate, and then in acid solution to glyoxylic acid and urea, the urea is determined as the xanthydrol compound —**A Machebœuf** Researches on the phospho amino lipides and the sterides of blood plasma and blood serum —**A Blanchetière** The hydrolysis of egg albumen by trypsin in relation with the formation of the diacipiperazines -**André Lwoff** The nutrition of *Polytoma uvella* (Chlamydomonadinæ flagellate) and the power of synthesis of the heterotroph Protists The mesotroph Protists

CAPE TOWN

Royal Society of South Africa, Oct 17 —**James Moir** An empirical formula for the absorption bands of ammonia, phosphine, and arsine (Robertson and Fox) in the near infra red The formula is that of a fundamental wave number multiplied by a vulgar fraction, the denominator of which depends on the gas the result is modified by small corrections involving constants and integers —**Th Schrire and E G Greenfield** On some new species of organisms isolated from *Xenopus Lævis* Three new organisms have been isolated from a spontaneous abscess in a frog One is of an Anthracoid nature and is extremely pathogenic to frogs and guinea pigs No toxin could be isolated from this organism —**J W C Gunn** The susceptibility of the African chameleon to digitalis bodies Amongst cold blooded animals, the grass snake and the toad (*Bufo*) are tolerant of very much larger doses than the frog (*Rana*) The South African clawed toad (*Xenopus lævis*) is, on the other hand, susceptible to the same degree as *Rana* Solutions of strophanthin, and tinctures of digitalis, squills, and strophanthus, were tested on *Xenopus* and *Chameleo* at the same time The symptoms in the chameleon are similar to those observed in the frog The heart is slowed and finally stops, with the ventricle in complete systole and the auricles engorged Pallor of the skin was noted in 40 per cent of cases The chameleon reacts to digitalis bodies like the frog, and does not show any special tolerance like the grass snake —**H Zwarenstein** The excretion of creatine in *Xenopus Lævis* The urine was collected by keeping 10 frogs in a glass receptacle for from one to five days Pure urine was obtained by tying the skin around the anus and releasing the ligature every 24 hours The results indicate that *Xenopus* excretes creatine, but not creatinine The amount excreted is about 0 04 mgm by each frog in 24 hours 100 c c of pure urine contains about 2 mgm creatine —**N E Brown** Contributions to a knowledge of the Transvaal Iridaceæ

ROME

Royal National Academy of the Lincei Communications received during the vacation —**G Giorgi** The sufficiency of the differential equations of mathematical physics Ritz's criticism (1908) of the electromagnetic theory based on differential equations of the field is refuted, it being shown that, in the classical interpretation of the problems of mathematical physics, the insufficiency is not in the differential equations, but in the accessory conditions If these are modified and the functional condition equivalent to that of succession is introduced in place of one of the conditions of the Cauchy type or of the infinity condition, integrals are obtained which are determined by the data usually presented in the effective problems —**L Lombardi and P Lombardi** Measurement of the local dissipations of energy in a circumscribed part of the magnetic circuit Details are given of an apparatus for the measurement in watts of the energy dissipated in a circumscribed part of the magnetic circuit, use being made of two induced windings, connected respectively with the two coils of an electro dynamometer and employed for measuring, one the principal flux, and the other the magnetomotive force used to maintain it in the core —**A Angeli, D Bigiavi, and Zwi Jolles** Scission of certain sulphohydroxamic acids The fact that, when sodium hydroxylaminosulphonate and benzaldehyde react, the detection of the hydroxamic acid formed by means of the violet coloration with ferric chloride is unsatisfactory, rests, according to Raschig, on the necessity of using a large amount of alkali and the temperature 70° to effect the decomposition of the sulphonate The authors find, however, that this reaction proceeds rapidly at the ordinary temperature and that the non appearance of the coloration with ferric chloride is due to the reduction of this reagent by the sulphite liberated —**P Vinassa** The fusibility of the elements and the electronic number Irregularities are observed when the fusibility of the elements is considered as a periodic function either of the atomic weight or of the atomic volume If however, the absolute melting point is divided by the electronic number, the result, termed the coefficient of fusion, ϵ is an exact multiple of 0 5 for all elements or, if the value obtained for helium is doubled, integral numbers According to this relationship, the element solidifying at 0° absolute should have a zero electronic number, that is, should consist of proton alone —**T Boggio** Bianchi's identity and gravitation homograph In continuation of the ideas developed in recent communications, a new and very simple demonstration is given of Bianchi's identity for the derivative of Riemann's homograph Further, application to the calculation of the vector gradient of Riemann's homograph leads to Einstein's gravitation homograph, the gradient of which is zero —**Silvia Martis in Biddau** Investigation of a rational expression for the powers of a matrix of the second order —**G Supino** Certain limitations valid for harmonic functions —**A Tonolo** Studies of the metric geometry of surfaces of linear four dimensional space —**G Colonnetti** New contribution to the theory of elastic co actions and to its technical applications (2) —**B Rossi** Study of the electric field in homogeneous anisotropic media Application of the theory of vectorial homographs to the problem of the electric field in anisotropic media greatly simplifies the treatment and often leads to a ready determination of the field —**A Carrelli** A new phenomenon of diffusion If the Raman effect is regarded as diffuse radiation foreseen from the quantistic theory of diffusion, the intensity of the Raman light becomes much less than the ordinary intensity The number of lines observed depends on the number of characteristic frequencies of the monads in the ultra red, but if the interpretation suggested is correct, the diffuse light should exhibit frequencies greater than the exciting frequency, the intensity of which is, however, less than that of the frequencies following Stokes's law —**E Persico** Optical resonance according to wave mechanics (2) —**G Canneri** The separation of pure yttrium from yttrium earths A method of purifying yttrium based on the fractional crystallisation of its double carbonates gives satisfactory results —**D Bigiavi** Relations between certain aromatic compounds The analogous compounds, benzyl

alcohol, phenylhydroxylamine, and benzenesulphenic acid, containing groupings including respectively carbon, nitrogen, and sulphur atoms, are able to undergo simultaneous reduction and oxidation, yielding toluene and benzoic acid (from benzaldehyde formed as an intermediate product), aniline and nitrosobenzene; thiophenol and benzenesulphinic acid Toluene, aniline, and thiophenol also exhibit analogies in behaviour, since they are able to yield respectively dibenzyl, hydrazobenzene, and diphenyl disulphide on oxidation —F Rodolico Phosgenite from Monteponi

Official Publications Received

BRITISH

Proceedings of the Society for Psychical Research. Part 100 Vol 38 December Pp 209-270 (London Francis Edwards, Ltd) 4s

The National Institute of Agricultural Botany Ninth Report and Accounts 1927-28 Pp. 19 (Cambridge)

Imperial Department of Agriculture for the West Indies Report on the Agricultural Department, St. Kitts Nevis, 1927-28. Pp iv+25 (Trinidad, B W I) 6d

Leeds University Report to the Worshipful Company of Cloth Workers of the City of London of the Advisory Committee on the Departments of Textile Industries and Colour Chemistry and Dyeing during the Session 1927 28 Pp 14 (Leeds.)

British Museum (Natural History) Picture Postcards Set F22 British Trees Alder 2 cards in Colour and 2 in Monochrome 6d. Set F23 British Trees Wild Apple 2 cards in Colour and 2 in Monochrome 6d Set F24 British Trees Ash 2 cards in Colour and 2 in Monochrome 6d Set F25 British Trees Beech 2 cards in Colour and 2 in Monochrome 6d Set F26 British Trees Sweet Chestnut 2 cards in Colour and 2 in Monochrome 6d Set F27 British Trees Horse-Chestnut. 2 cards in Colour and 2 in Monochrome 6d Set F28 British Trees Sycamore 2 cards in Colour and 2 in Monochrome 6d (London British Museum (Natural History).)

Quarterly Journal of the Royal Meteorological Society Vol 54 No 228 October Pp. 287 360 (London Edward Stanford Ltd) 7s 6d

The Ninety fourth Annual Report of the Royal Cornwall Polytechnic Society New Series, Vol 6 Part 1 1927 Pp. xv+75+14 5s The Ninety fifth Annual Report of the Royal Cornwall Polytechnic Society New Series Vol 6 Part 2 1928 Pp. xvi xxviii+77 182+13 5s. (Camborne)

Union of South Africa Department of Agriculture. 13th and 14th Reports of the Director of Veterinary Education and Research Part 1 Pp 720 10s Part 2 Pp 731 1270 10s. (Pretoria Government Printing and Stationery Office)

Transactions of the Mining and Geological Institute of India. Vol 22 Part 3 October Pp 177 274+x+plates 27 48 (Calcutta.) 4 rupees

Journal of the Royal Microscopical Society Series 3, Vol 48 Part 4 December Pp. xvi+379-508 (London) 10s net.

Society of Chemical Industry Chemical Engineering Group Proceedings Vol. 9 1927 Pp 147 (London) 10s 6d

Journal of the Indian Institute of Science Vol 11A, Part 10 1 Studies on Soil Protozoa, Part 1 Protozoan Fauna of some Mysore Soils by H S Madhava Rao ii Studies on Soil Protozoa Part 2 The Function of Mitochondria in some Soil Protozoa, by H S Madhava Rao Pp 111 119+1 plate. 1 rupee Vol 11A Part 11 1 Studies in Enzyme Action Part 1 Amylase from Cholam (*Sorghum vulgare*) by V N Patwardhan and Roland V Norris ii Studies in Enzyme Action Part 2 The Nature of Amylase by D Narayanamurti and Roland V Norris Pp. 121 139 1 8 rupees (Bangalore)

FOREIGN

Spisy vydávane Přírodovědeckou Fakultou Masarykovy University (Publications de la Faculté des Sciences de l Université Masaryk) Čís. 96 *Lonchopteris Jongmansi* nov sp z kamenouhelné pánve rosicko oslavanské (*Lonchopteris Jongmansi* nov sp. du bassin houiller de Rosice Oslavany en Moravie (Tchechoslovaquie).) Napsal J Augusta. Pp 11 Čís 97 Pásmo porfyroidové ve Vrbenském devonu na východním okraji Vysokého Jeseníku (La zone de porphyroides dévoniens de Vrbno aux abords Est de Vysoký Jesenik en Silésie). Napsal Jan Stejskal Pp 34 Čís. 98 La réfraction de l'hélium et de l argon et sa dépendance des pressions inférieures à une atmosphère Par Fr Schacherl. Pp. 15 Čís 99 La réfraction de l oxyde de carbone, de l azote et de l oxyde azoteux et sa dépendance des pressions inférieures à une atmosphère. Par Fr Schacherl Pp. 29 Čís 100 Contribution à l etude des propriétés projectives du contact. Par Miroslav Konecný Pp 10 Čís 101 Quod momentum significet *Carex pediformis* in stepposis silvaticis Europae mediae Scripsit J Podpěra Pp 22 Čís. 102 Generis Trigonella L revisio critica, I Scripsit G Širjaev Pp. 57 (Brno A. Piša)

Spisy Lékařské Fakulty Masarykovy University, Brno Československá Republika. Svazek 6, Spis 52 60 (Publications de la Faculté de Médecine, Brno Tchécoslovaquie, Tome 6 Fascicule 52-60) Pp. 64+40+8+6+14+21+12+61+24 (Brno A. Piša) 40 Kč.

Biologické Spisy Vysoké Školy Zvěrolékařské, Brno Československá Republika. Svazek 6, Spis 76-95 (Publications biologiques de l École des Hautes Études Vétérinaires, Brno Tchéchoslovaquie, Tome 6, Fascicule 76-95) Pp. 10+28+28+37+16+15+7+7+37+6+7+6+7+13+8+28+5+22+11+5 (Brno A. Piša.) 40 Kč

Práce Moravské Přírodovědecké Společnosti, Brno Československo. (Acta Societatis Scientiarum Naturalium Moraviae Brno, Čechoslovakia.) Svazek 3, Spis 21 32 (Tomus 3, Fasciculus 21 32.) Pp. 344 80 Kč Svazek 4, Spis 33-41 (Tomus 4, Fasciculus 33 41.) Pp 536. 100 Kč. (Brno A. Piša.)

Sborník Vysoké Školy Zemědělské v Brně, ČSR. (Bulletin de l École Supérieure d Agronomie, Brno RCS.) Sign. C12 Mykologický rozbor rozkladu rostlinné hmoty a jeho význam pro praksi konservování píce (Analyse mycologique de la décomposition de la matière végétale et son importance pour la pratique de la conservation du fourrage) Napsal Dr Miloš Bayer Pp. 64+8 tabulkami Sign C13 Příspěvek k rozšíření zoocecidií v Jugoslavii a zemích sousedních (Contribution à la distribution des zoocécidies en Yugoslavie et dans les pays voisins) Napsal Dr Eduard Baudyš Pp. 90 Sign C14 Studie o významu štítné žlázy a brzlíku pro opérování vzrůst a jakost masa drůbeže (Studies on the Importance of the Thyroids and of the Thymus in the Feathering, Growth and Flesh-quality in the Poultry) Napsal Michail Nevalonnyj Pp. 137 Sign D9 Lesnické pokusnictví p stební Nástin soustavy a pracovních zásad (The Silvicultural Experimentation a Short Outline of the System and Work s Manner). Napsal Prof Jos Konšel Pp 52 Sign D10 Stálost rostlinných buněk proti vyschnutí (La stabilité des cellules végétales contre la sécheresse). Napsal Prof Vasil Sergejevič Iljin Pp 18. Sign D11 Závislost přírůstku dřevní hmoty na obsahu ústrojných látek v půdě Několik poznámek k práci A Němce a K Kvapila Studie o chemické povaze profilů lesních půd Napsal Alexandr Leporsky Pp 25 (Brno A Piša.)

Methods and Problems of Medical Education Eleventh Series. Pp iii+263 (New York The Rockefeller Foundation)

Journal of the Faculty of Agriculture, Hokkaido Imperial University, Sapporo Japan Vol 24 Part 1 Beitrag zur Chemie der Haut (I. Die Hydrolyse in sauren und alkalischen Medien), von G Grasser Dr Sh Taguchi und Sun Tau Beitrag zur Chemie der Haut (II Einfluss der Ascher und Beiz Methoden auf die chemische Zusammensetzung der Blössen) von G Grasser und H Nakanishi Die gerbenden Eigenschaften der Methylendinaphthole von G Grasser und K Hirose Die Reduction der Bichromate zu basischen Chromsalzen von G Grasser und T Nagahama. Pp 88. (Tokyo Maruzen Co Ltd)

Diary of Societies

FRIDAY, FEBRUARY 1

ROYAL SOCIETY OF MEDICINE (Otology Section), at 10.30 A M —S Scott Vertigo —A R Tweedie Some Notes on the Rotation Caloric and Galvanic Tests —Dr A I Yates Demonstration of Some Graphic Records of Instability illustrative of Cases referred to by Mr Sydney Scott.

ANDERSONIAN CHEMICAL SOCIETY (at Royal Technical College Glasgow), at 3 15 —Dr R Hay Manufacture of Sulphuric Acid by the Contact Process

ROYAL SOCIETY OF MEDICINE (Laryngology Section) at 5

ROYAL SANITARY INSTITUTE at —F R Humphreys and others The Civilian Population and Chemical Warfare

ROYAL COLLEGE OF SURGEONS OF ENGLAND at —Prof C A Pannett Local Anæsthesia in the Surgery of the Upper Abdomen

PHILOLOGICAL SOCIETY (at University College) at 5 30 —Prof V G Childe Philology and Archæology

INSTITUTION OF MECHANICAL ENGINEERS at 6 —Prof A S Eddington Engineering Principles in the Machinery of the Stars (Thomas Hawksley Lecture)

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (jointly with Liverpool Section) (at Engineers Club Manchester) at 7 —Dr F Challenger The Sulphur Compounds of Shale Oil and Petroleum

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section) at 7 —J I Carr Recent Developments in Electricity Meters with particular reference to those for special purposes.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group—Informal Meeting) at 7 —P Fripp Some Aspects of Craftsmanship

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (jointly with Institute of Chemistry) (at Thomas Café Swansea) at 7 30 —E A Tyler Further Notes on Pure Chemicals.

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting) at 7 30 —T H Cross Notes on Road Construction

TEXTILE INSTITUTE (Lancashire Section) (jointly with Nelson Textile Society) (at Nelson), at 7 30 —O S Hall The Economic Aspect of some Developments in the Textile Industry (Lecture).

ROYAL SOCIETY OF MEDICINE (Anæsthetics Section), at 8 30 —Dr R. D Lawrence Post operative Acidosis.

ROYAL INSTITUTION OF GREAT BRITAIN at 9 —Prof J L Myres Geometrical Art in S.E Europe and Western Asia

SATURDAY FEBRUARY 2

ROYAL INSTITUTION OF GREAT BRITAIN at 3.—Dr E Cammaerts Flemish and Belgian Art (III) Genre Painting

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch) (at College of Technology Manchester), at 4 30 —J O Gray Works Accounting and Foundry Practice.

MONDAY FEBRUARY 4

ROYAL SOCIETY EDINBURGH at 4 30 —Dr Nellie B Eales On the Anatomy of a Fœtal African Elephant *Elephas africanus* (*Loxodonta africana*) Pt. 3—The Contents of the Thorax and Abdomen and the Skeleton —A. D B Smith and J R Brown The Rôle of Inbreeding in the Development of the Jersey Breed of Cattle in England —Dr A. W Greenwood and J S. S Blyth Experimental Study of the Thyroid Gland in the Domestic Fowl with Special Reference to Plumage Characterisation —*To be read by title only* —Prof C W Stump A Human Blastocyst *in situ*.

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4 30 —P J Le Riche Scientific Proofs of a Universal Deluge

BIOCHEMICAL SOCIETY (at Lister Institute), at 5 —H Chick and M H Roscoe (*a*) Methods for the Assay of Vitamins B_1 and B_2 (*b*) On the Separation of Vitamins B_1 and B_2 from Yeast.—M H Roscoe Rats Reared Eight Months after Weaning on Diets Deprived of B Vitamins —T Lumsden The Effect of Various Reagents upon Cells Cultured *in vitro* —L F Hewitt: Hormones of the Anterior Pituitary Lobe —N F Maclagan The Use of Decinormal Hydrochloric Acid for

Standardising Electrometric pH Measurements —E Boyland The Sequence of the Formation of Phosphoric Esters and Carbon Dioxide in Fermentation by Dried Yeast.—R Robinson and E. King Hexose monophosphoric Ester —E King and W T J Morgan Methylated Derivatives of Hexosemonophosphoric Ester —W T J Morgan The Constitution of Hexosediphosphoric Ester —*Demonstrations (from 3 30)* —G H Eagles Growth of Vaccine Virus in Tissue Culture —A Felix Flocculer and Granular Agglutination Phenomena.—T Lumsden and A C Kohn Speyer Serum as a Culture Medium for Serological and Other Tests —E M Hume N S Lucas, and H Henderson Smith Three Common Marmosets (*Hapale jacchus* Linn) Bred in Captivity with the Aid of Ultra violet Irradiation

ROYAL INSTITUTION OF GREAT BRITAIN at 5 —General Meeting

ROYAL COLLEGE OF SURGEONS OF ENGLAND at 5 —Prof R. J McNeill Love The Treatment of some Acute Abdominal Disorders

SOCIETY OF ENGINEERS (at Geological Society), at 6 —A. K Dodds Berwick s Bridges (Presidential Address).

INSTITUTION OF AUTOMOBILE ENGINEERS (Bristol Centre) (at Merchant Venturers Technical College Bristol), at 6 45.—Dr F W Lanchester Coal Ignition

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7 —W R Rawlings and others Discussion on Earthing and the Safety of the Public

RAILWAY CLUB (57 Fetter Lane) (Annual Meeting) at 7.30 —Presidential Address

ROYAL SOCIETY OF ARTS at 8.—Dr C H Lander The Treatment of Coal (Cantor Lectures) (III).

SURVEYORS INSTITUTION at 8 —H J Vaughan The Significance of the Timber Merchant in Estate Forestry

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall) at 8 30.

TUESDAY FEBRUARY 5

ROYAL SOCIETY OF MEDICINE (Orthopædics Section), at 5

ZOOLOGICAL SOCIETY OF LONDON at 5 30 —Secretary Report on the Additions to the Society s Menagerie during the months of November December 1928 and January 1929 —E G Boulenger Remarks on the Behaviour of Certain Inhabitants of the Society s Aquarium —G C Robson On a Case of Bilacteral Hectocotylisation in *Octopus rugosus* —G C Robson and Prof L Joubin On a New Species of *Macrotritopus* (Cephalopoda) obtained by Dr J Schmidt s *Dana* Expedition with Remarks on the Genus.—W N F Woodland On a New Species of *Rhabdometra* with a Note on the Nematodiform Embryos of *Anonchotaenia globata* (Cestoda) —H C Wilkie The Attachments of the Auditory Ossicles of the Common Mole (*Talpa europæa*).—Dr H Boschma The Fungidæ (Anthozoa) collected by Mr Cyril Crossland at Tahiti and Neighbouring Islands —C S Garnett Some Notes and Observations on the Flight of Flying Fishes

INSTITUTION OF CIVIL ENGINEERS at 6

INSTITUTION OF ELECTRICAL ENGINEERS (East Midland Sub-Centre) (at University College Nottingham) at 6 45 —W B Woodhouse Overhead Electric Lines

INSTITUTION OF ELECTRICAL ENGINEERS (North Western Centre) (at Engineers Club Manchester) at 7 —J Wright and C W Marshall The Construction of the Grid Transmission System in Great Britain

INSTITUTE OF METALS (Birmingham Local Section) (jointly with Birmingham Metallurgical Society and Staffs. Iron and Steel Institute) (at Engineers Club Birmingham), at 7 —D J MacNaughtan Electrodeposition

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group), at 7

INSTITUTION OF AUTOMOBILE ENGINEERS (Coventry Graduates) (at Broadgate Cafe Coventry), at 7 15 —R. A. Clepham Free Wheels

INSTITUTION OF ELECTRICAL ENGINEERS (Dundee Sub Centre) (at Lamb s Restaurant) at 7 30 —Discussion on Earthed *versus* Insulated Systems

INSTITUTION OF AUTOMOBILE ENGINEERS (at Royal Society of Arts) at 7 45 —H K Thomas Some Investigations into the Performance of Tubular Radiators for Motor Vehicles

HULL CHEMICAL AND ENGINEERING SOCIETY (at Grey Street Hull) at 7 45 —G H Barron Ice making

TELEVISION SOCIETY (at Engineers Club Coventry Street) at 8 —R. R Poole Methods of Light Modulation in Receivers

WEDNESDAY FEBRUARY 6

ROYAL COLLEGE OF SURGEONS OF ENGLAND at 5 —Prof C P G Wakeley The Etiology Pathology and Treatment of Tumours of the Intestinal Tract.

ROYAL INSTITUTION OF GREAT BRITAIN at 5 15 —Prof J S Huxley Evolution and the Problem of Species (II)

GEOLOGICAL SOCIETY OF LONDON at 5 30 —E St. John Burton The Horizons of Bryozoa (Polyzoa) in the Upper Eocene Beds of Hampshire —M Black The Upper Estuarine Series of Yorkshire.

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section) at 6 —Dr B Hodgson I S Harley and O S. Pratt The Development of the Oxide coated Filament.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society), at 8 —Prof T P Hilditch and Eveline E Jones The Fatty Acids and Component Glycerides of some New Zealand Butters.—A S Dodd A New Test for Boric Acid and Borates.—B E Dixon The Determination of Beryllium in Rocks

ROYAL SOCIETY OF ARTS at 8 —Sir J Alfred Ewing The Vibrations of Railway Bridges an Example of Co operative Research (Trueman Wood Lecture)

ROYAL SOCIETY OF MEDICINE (War and Surgery Sections) at 8 30 —Group-Capt H. V Wells (War), Sir Percy Sargent (Surgery), and others Special Discussion on The Necessity for Early Diagnosis in the Treatment of Spinal Injuries

ROYAL MICROSCOPICAL SOCIETY (Biological Section)

SOCIETY OF CHEMICAL INDUSTRY (Nottingham Section).—Dr T Callan Simplified Methods of Electrometric Analysis

THURSDAY FEBRUARY 7

ROYAL SOCIETY, at 4 30 —Sir Ernest Rutherford Dr F W Aston Dr J Chadwick Dr C D Ellis R H Fowler and Prof. O W Richardson Discussion on The Structure of Atomic Nuclei

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15 —Sir William Bragg The Early History of X rays (II)

CHEMICAL SOCIETY at 8 —C S. Gibson and J L Simonsen Indian Turpentine from *Pinus longifolia* Roxb Part V The Oxidation of d Δ^3-carene with Beckmann s Chromic Acid Mixture —A. W Chapman A New Method for Preparing Substituted Diphenylamines —C S Gibson, J D A Johnson and B Levin Compounds of the Tryparsamide Type Part I Resolution of N phenylalanine 4-arsinic Acid and of its Amide —C S Gibson and J D A Johnson 10-Chloro-5 10-dihydrophenarsazine and its Derivatives. Part VII The Synthesis of the 1 methyl and of the 3-methyl homologues.

ROYAL SOCIETY OF MEDICINE (Tropical Diseases Section), at 8.15 —Monkeys and Human Disease —R. I Pocock Zoological Relationships of Primates (Apes and Monkeys).—R Lovell Bacterial Diseases —E Hindle Virus Diseases —Dr J G Thomson Protozoal Diseases —T W M Cameron Helminthic Diseases —Dr V B Wigglesworth Insect Diseases.—Col A. E Hamerton Morbid Anatomy

INSTITUTE OF CHEMISTRY (Manchester and District Section) (at Manchester).—Prof C K Ingold Mechanism of Atomic Structure Significance of the Thiele Hypothesis

SOCIETY OF DYERS AND COLOURISTS (West Riding Section).—A. J Hall The Action of Alkalis on Cotton and Artificial Silks.

INSTITUTION OF MECHANICAL ENGINEERS (Glasgow Branch)

FRIDAY, FEBRUARY 8

ROYAL SOCIETY OF ARTS (Indian Meeting), at 4 30.—Capt. E J Headlam The History of the Indian Marine

ROYAL ASTRONOMICAL SOCIETY (Anniversary Meeting), at 5 —Presentation of the Gold Medal to Prof E Hertzsprung for his Determination of the Distance of the Lesser Magellanic Cloud and other Pioneering Work in Stellar Astronomy

PHYSICAL SOCIETY (at Imperial College of Science) at 5 —L F Stanley The Construction and Calibration of a Sensitive Form of Pirani Gauge for the Measurement of High Vacua.—H C Webster (*a*) Photographic Measurement of the Relative Intensities of the $L\alpha_1$ $L\alpha_2$ $L\alpha_3$ Lines of Silver (*b*) Spark Satellites of the $L\alpha$ Lines of Silver —Demonstration of a New Instrument for the Rapid and Accurate Determination of the Specific Gravities of Solid Substances by W A Benton

ROYAL COLLEGE OF SURGEONS OF ENGLAND at 5 —Prof R. T Payne The Treatment of Varicose Veins and Varicose Ulcers by Injection

BRITISH PSYCHOLOGICAL SOCIETY (Æsthetics Section) (at Bedford College for Women) at 5 30 —Dr H Lowery Musical Memory and Rhythm

MALACOLOGICAL SOCIETY OF LONDON (at University College) at 6.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 6 —I A Legros and others Discussion on The Profession of the Mechanical Engineer

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Newcastle upon Tyne), at 6 —Dr G W Todd The Prediction of the Properties of Engineering Materials from their Ultimate Structures

INSTITUTION OF ELECTRICAL ENGINEERS (London Students Section), at 6 15 —H H Taylour Electric Welding

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Informal Technical Talk) at 7 B C Wickison Lantern Slides

GEOLOGISTS ASSOCIATION (Annual General Meeting) (at University College) at 7 30 —Prof A Morley Davies Formal Migrations since the Cretaceous Period (Presidential Address)

INSTITUTE OF METALS (Sheffield Local Section) (at Sheffield University) at 7 30 —W T Griffiths Some Recent Developments in Nickel Metallurgy

JUNIOR INSTITUTION OF ENGINEERS at 7 30 —Dr A E Dunstan Recent Developments in the Art of Oil Cracking (Lecture).

SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (at Royal Society of Arts) at 8 —Prof W E Gibbs The Rôle of Surface Energy in Chemical Engineering

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section) at 8 30 —R. F Moore and Mr Scott Clinical and Pathological Report of Bilateral Glioma Retinæ —R F Moore Cirsoid Aneurysm of the Visual Cortex —B Graves Scleral Illumination

ROYAL INSTITUTION OF GREAT BRITAIN at 9 —C E R. Sherrington Recent Problems of Rail Transport at Home and Abroad

SATURDAY, FEBRUARY 9

ROYAL INSTITUTION OF GREAT BRITAIN at 3 —Dr S Marchant Music in Cathedral and Collegiate Churches (I)

MINING INSTITUTE OF SCOTLAND (at Edinburgh).

PUBLIC LECTURES

FRIDAY, FEBRUARY 1

LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE at 5 —C E R Sherrington The Steam Railways and the Localisation of Industry in the Nineteenth Century

SATURDAY FEBRUARY 2

HORNIMAN MUSEUM (Forest Hill), at 3 30 —Miss M A. Murray The Ancient Egyptian Potter and his Clay

MONDAY, FEBRUARY 4

KING S COLLEGE OF HOUSEHOLD AND SOCIAL SCIENCE at 5 15 —F Rodd Saharan Nomads

EAST ANGLIAN INSTITUTE OF AGRICULTURE (Chelmsford), at 7 —J A Venn Some of the Causes of the Agricultural Depression and Suggested Remedies

TUESDAY FEBRUARY 5.

UNIVERSITY COLLEGE, at 5 30 —Julia Bell The Handicapping of Men by Diseases transmitted by but not developing in Women

FRIDAY FEBRUARY 8

LONDON SCHOOL OF ECONOMICS at 5 —C E R. Sherrington Railway Electrification and the Redistribution of Industry

SATURDAY, FEBRUARY 9

HORNIMAN MUSEUM (Forest Hill), at 3 30 —H N Milligan Life Beyond the Low Tide Mark.

SATURDAY, FEBRUARY 9, 1929

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Modern Witchcraft

THE symposium on spiritualism which, as already noted in NATURE, the *Daily News* has been publishing, is of some importance even though it be merely an indication of the deplorable and sometimes almost pathetic attitude of prominent laymen towards the scientific method of approaching obscure problems From the great majority of the articles submitted, it would seem that not only are the methods of science wholly misunderstood, but also that there is little appreciation of the meaning of evidence when applied to physical and psychological matters This is the more surprising when we remember that prominent legal writers have contributed to the series, and aptly illustrates the fact that the human mind finds it difficult to apply the same standards of evidence to subjects which differ both in their general content and above all in their emotional significance

The terms of reference under which the symposium was conducted were grouped under three heads First came the question of deciding if the claims of spirit communications made by spiritualists are proved or disproved, or indeed if they can be proved or disproved Secondly, the evidence or experience on which the writers' opinions were based was requested, and finally, a reply was sought to the question whether the growth of spiritualistic practices was likely to prove a menace or otherwise to mind or body Apart from the confusion between 'spirit communications' and 'spiritualistic practices,' the terms are simple and, whilst not well adapted for scientific discussion, are broad enough for popular opinion Moreover, the elasticity of the terms might have given the writers good excuse to present some of the evidence in detail, which would have been of interest to the general reader

From this point of view, however, the symposium cannot be called a success It must be clearly remembered that the scientific method is the only one properly applicable to these alleged supernormal phenomena Theories based upon theological or philosophical speculation have little real value until the facts which underlie them are found to be so far related to the known that they can be properly described, and the phenomena concerned repeated at will, or at least adequately and repeatedly observed Until this is done the alleged facts are themselves suspect The believers in early witchcraft would have provided better evidence for their faith than that which the exponents of the modern variety have contributed to

this symposium Statements are made and stories related without any sound evidence being adduced in their support Similarly, the opponents of the spiritualists have to a great extent contented themselves with arguments which leave untouched the kernel of the problem We are not concerned, for example, with whether alleged spirit communications are trivial or profound, sublime or ridiculous To assert that, because in so many cases they are trivial and ridiculous, *therefore* they cannot proceed from spirits, is to assert that we have knowledge as to what spirit communications *ought* to be like, and no such knowledge exists Again, when it is asserted that certain of the phenomena are explained by 'telepathy,' the statement has no meaning Telepathy does not explain anything It is merely a name invented to describe a supposed process concerning which we know nothing, not even that it exists

Attempts have been made repeatedly to demonstrate experimentally the existence of telepathy Probably the best known trials were those undertaken with Prof Gilbert Murray acting as percipient One might have supposed that, with so distinguished a collaborator, experiments would have been devised which would have had at least some relation to ordinary scientific procedure Such, however, was not the case The tests partook much more of the nature of parlour games, and we understand that suggestions for further and properly controlled experiments have been rejected The same story echoes down the ages The writers of the *Daily News* symposium have little to add to the questions of Porphyry and the answers of Iamblichus, the stories of St Augustine and the caustic satire of Lucian The problem was the same then as now The excuses and subtle methods of the medium Alexander of Abonutichus were identical with those used to day in the séance rooms of West London In the circumstances, it is difficult to be surprised at the general attitude of modern scientific men who are apt to regard the witchcraft of to-day in the same light as they regard the witchcraft of yesterday, as a belief based upon fraud, delusion, and hypocrisy

Now, whatever may be the truth underlying alleged supernormal phenomena, there is no doubt that an increasingly large number of persons believe in their reality Even if such phenomena have never occurred, it is indubitable that human beings of all ages and times have reported them in terms of such remarkable similarity that it is difficult to believe that similar sets of circumstances have not originated them. For example, the stories of haunting phenomena have been so similar for hundreds of years that we cannot doubt that certain events do take place in certain houses which lead the occupiers to describe their experiences in the same way and to maintain that they are inexplicable Now, apart from the question of the normal or supernormal character of the phenomena of haunting, these facts alone are worthy of the attention of science What are precisely the circumstances which lead people in ordinary life to describe in detail the appearance of phantoms which are not rarely seen by more than one person at the same time? What are the conditions which lead persons widely separated in time and space to describe the appearance of showers of stones which seem to fall out of the air (the so called stone throwing poltergeist)? Again, how can we describe adequately those abnormal psychological mechanisms which result in cases of multiple personality, where certain of the so called secondary personalities betray knowledge of persons and events which careful inquiry fails to prove could at any time have been within the normal content of the subject's mind? Precisely the same problem is presented regarding the beliefs of primitive peoples Phenomena, inexplicable to the natives themselves, and also to European observers, have been reported from all parts of the world

The *Daily News* symposium is some slight indication of how superstition and credulity are fostered on account of our ignorance of the origin and basis of these world wide tales We cannot doubt that a more complete and systematic investigation is desirable, but at the same time it would seem that it is not the duty of the ordinary scientific man to undertake researches in this field The first necessity is a thorough knowledge of the art of mystification, and this implies a good acquaintance with those psychological factors underlying conscious and subconscious deception, pathological lying, false memory, number preferences, and similar conditions The ordinary physicist does not possess any of these qualifications, and the results of lacking them can be observed if we study the amazing history of the N-rays to which Mr Campbell Swinton alluded in his article in the *Daily News*

The subject is at present outside the range of competent scientific inquiry, and thereby a mass of valuable information is being lost Whatever may be the explanation of the belief in supernormal phenomena, we can scarcely deny that it has had an enormous effect upon the happiness and misery of mankind. Belief in these occurrences appears to

be increasing, and the only method of checking its progress or confirming its basis is the application of impartial, unemotional, and rigid scrutiny of the alleged facts by men trained to detect sources of error and possessing some knowledge of the history of the problem in its relation to human thought Such inquiry, we think, cannot be much longer delayed The symposium we have been considering is a fair indication of the chaos in the mind of the public, and the recent prosecution of a 'medium' by the State shows the same uncertainty and hesitation in the mind of the Government An inquiry conducted on scientific lines would be a task of great magnitude and considerable difficulty On the other hand, if the only result were to fail to find any evidence of 'supernormal' activity, a very important body of material would have been collected which must throw a good deal of light on the psychological questions involved in mal observation and error, not only in civilised peoples but also among the inhabitants of countries which have not at present wholly absorbed the culture of the West

The Making of an Epoch

The Discovery of the Rare Gases By Prof Morris W Travers Pp vii + 128 (London Edward Arnold and Co, 1928) 15s net

THE discovery of a new chemical element is a feat of a kind that is unique, and in one aspect it may be said to be above all other discoveries For the worker who finds a new natural law of *action*, however great it may be, must temper his pride with the reflection that inevitably his law will in time be shown forth as but a part of some still greater one, incorporating his own "After me cometh a builder Tell him, I too have known" But the existence of an element is a fact of the universe, an element is a cosmic unit, superior to the accidents of place and time, it will outlast man who discovered it for himself, ironically enough for the chemist who finds it, it can even outlast chemistry and all that works by chemistry in Nature It is this which justifies us in hailing Priestley and Scheele, Berzelius, Davy, Mosander, Bunsen, Rayleigh, Ramsay and Travers—and let us add Mme Curie, Hevesy and Coster—together with the two score or so successful followers of their methods, as being privileged far beyond the ordinary, so also, of course, the discoverers of the electron and of the proton To tell the full tale of any one of these investigators' work worthily, and while first-hand recollection is still there to be drawn upon, is to give us, and to leave to our scientific posterity, something to be grateful for

What it is in Ramsay's discoveries which makes them conspicuous among the greatest work of this kind, needs little explanation now, when thirty years have given time for even those who were at first backward or hastily critical to be taught Let those who have watched the unrolling of the scroll since 1893 pause to recall how they were first astounded by Rayleigh and Ramsay's finding something new in air—in air!—then by its being an element—an inert, monatomic element!—then by Ramsay's suddenly producing a quite new gaseous surprise out of quite another magical hat, the materialisation of a spectral line scarcely anyone had seen, and how then there came the period of suspense, while the chemical world talked or waited or went about its business, and Ramsay, and Travers with him, strove to push on into the new country that they believed in—and suddenly got there, with krypton, neon, and xenon A whole unsuspected group! No other chemist has done it Thereafter a well earned increment to the group came with Rutherford's radium emanation, the weighing of emanation by Ramsay and Whytlaw Gray, the discovery by Ramsay and Soddy of the formation of helium from it, with Rutherford's precise identification of his α rays with helium particles, all these rounded off one astonishing chapter and began another Now, in this later chapter—would that Ramsay could have lived to see it—the newer generation of chemists and physicists familiarly use Ramsay's elements as fixed and indispensable bench marks in the atomic surveying whereby Mendeléeff's atomic geography is seen to fall into one consistent frame, and factories bottle the gases in cylinders Seen thus, the whole thing has only one parallel, and that is Priestley's discovery of oxygen, and its aftermath The parallelism can be traced out quite closely, and the debt of the twentieth century to Ramsay in physical science is proving not less than that of the nineteenth to Priestley

Accounts of the work on the inert gases have been issued before, as for example by Rayleigh as regards argon ("Scientific Papers," vol 4, 188 201), and in his son's "Life of Lord Rayleigh", by Ramsay ("Gases of the Atmosphere," 3rd edit, 148 269), and by Tilden in his "Life" of Ramsay (1918) For this reason it is natural that some of what Dr Travers tells in the present volume is broadly familiar, but there is much that will be new, and greatly welcome, to its readers For a story of classical discoveries cannot ever be told

to our full satisfaction by their originator, because he either does not realise or else cannot in modesty tell his own traits and behaviour in action, upon which his success so largely depends, and the trivial, yet to us interesting, personal incidents of the work are to him irrelevant. Even his familiar letters miss out much that we can only guess at; whilst a later biographer, however sympathetic, can rarely be as circumstantial as we should like; of strategy we read little, of tactics a good deal, and of behaviour under fire only rarely. Here, however, is an account at first hand from one who was a brilliant and essential junior partner in all but the very first part of Ramsay's work on the rare gases; and it is based upon Ramsay's own MS. papers and laboratory notes, handed over to Dr. Travers by Lady Ramsay and Mrs. Tidy with an invitation to arrange them. Dr. Travers has brought all his own enthusiasm to renew that which created his material. Consequently, the spirit of the account as a whole, and the numerous circumstances that are recaptured, reveal to the reader more vividly than any other written word the indomitable artillery of Ramsay's opening attack on a problem, and the flashing élan with which he launched his full force into the breach to carry the citadel.

The genesis of Lord Rayleigh's fundamental work on gaseous densities, out of which came his own and Ramsay's discovery of argon, lay in his plan, formed in 1882, to test Prout's hypothesis. Dr. Travers dwells instructively and at length upon this point, which has also been mentioned by Ramsay himself (loc. cit.) and by Tilden in his "Life." (It is curious that both for Cavendish and for Rayleigh it was the same element—nitrogen—which began by being a nuisance and was in each case turned, under masterly hands, into a source of rich knowledge.) Dr. Travers, in treating of the ensuing joint researches (four chapters are devoted to argon), says:

"Lord Rayleigh and Ramsay stand out from amongst their contemporaries, chemists and physicists, as the two men who alone realised the significance of the apparent discrepancy in the densities of nitrogen. They were also the two men who alone were capable of developing the discovery. In genius, method, and temperament each was in many respects the opposite and the complement of the other. No modern discovery ever awakened more interest than the discovery of argon; never did scientific men receive more gratuitous advice or criticism; but never was advice or criticism more completely sterile."

Ramsay, on his part, brought to the problem, besides his own qualities, a technique in glass-blowing and in the handling of gases which all his Bristol and London work had fostered (and at that time there were very few glass-blowing chemists), and he brought a repertoire which included an unsurpassed wealth of chemical fact and a great deal of quite recent physics. For example, he tried magnesium as the absorbent for nitrogen because, as he tells us (loc. cit., 158), he had noticed its property several years before while trying to synthesise ammonia in the presence of various heated metals. The property was not at all common knowledge among chemists. Again, the idea that the ratio of the specific heats of a gas gives a clue to its molecular complexity must have been little known to the average chemist, and Dr. Travers shows how it was doubted by many physicists; yet Ramsay was not merely aware of the idea, but had actually applied it experimentally in studying some organic compounds; so he was able at once to turn to it—the only possible test—to try the complexity of the argon molecule. As Lord Rayleigh pointed out, it was only when that had been done that they allowed themselves to utter a word suggesting that argon was an element.

Arising out of the last mentioned measurements, Dr. Travers tells us that Ramsay did the whole of them, including controls, between Monday morning and Friday evening; and he adds the significant remark: "That work carried out in this manner could be so highly productive was due to Ramsay's insight into the essentials of a chemical problem, and his judgement as to the degree of experimental accuracy required in order to furnish adequate proof of the particular hypothesis which he was investigating." With this we may link another quotation given from Rayleigh and Ramsay's Royal Society paper: "Although the evidence of the existence of argon in the atmosphere ... appeared overwhelming, we have thought it undesirable to shrink from any labour that would tend to complete its verification." These principles permeate the whole subject of Dr. Travers's book.

As all who have been privileged to be with Ramsay know—and let me add, what Dr. Travers could not, that the following remark applies to him also—the speed with which he arranged experiments and made them go was extraordinary. From the start of his share of the work leading to argon, it took him a month to obtain "the gas which I think I have got" (written to Rayleigh), and about another month to isolate it in bulk and

find its density (August 1894) For speed, however, the discovery of helium in March 1895 would be hard to match, for it took a fortnight Was ever 3s 6d better spent? Incidentally, we are reminded by Ramsay's MS notes (here generously reproduced in facsimile) that helium was provisionally christened "krypton" until Crookes's telegram came "Crypton is helium 58749 Come and see it"—"Went and saw it," is Ramsay's laconic addition to his MS copy This chapter (v) will be found very interesting

The ensuing three years are covered in as many chapters, and with Chap ix (May and June 1898), where Dr Travers's own memories of all the comings and goings are at their keenest, we reach the best of the twelve in the book Ramsay and Travers's irresistible pinning down of krypton and xenon at their very first handling of liquid air, and the unforgettable moment when neon blazed into their ken, are made the culminating point of a dramatic and yet matter of fact story, the end of which is rightly drawn at the close of Travers's work with Ramsay

The frontispiece, diagrams, and the ample facsimiles of MSS are happily chosen and are well reproduced By some strange oversight, nearly all the dates in the text are wrong, but as the error is either one decade or two, it jerks us into the wrong century and the intention is obvious A few other slips in writing (for example, p 67) will doubtless be put right for later issues The format and type work are dignified, as the book deserves

All who worked with Ramsay, very many who did not, and every young student of chemistry or of physics, should read this book, they will gain great pleasure and new inspiration For, as Dr Travers writes of Ramsay, and finely exhibits in this volume, "He was a great friend, a great leader, and a great man" IRVINE MASSON

Timber Exploitation

Manual of Forest Engineering and Extraction By J F Stewart Pp xv + 188 + 100 plates (London Chapman and Hall, Ltd, 1927) 15s net

MR STEWART'S book has been written primarily for forest students, but it should also be useful to those engaged in timber exploitation in many parts of the world The subject dealt with is a very wide one, covering as it does the preparation of streams for floating, river surveys, the felling and clearing of areas, logging operations, including the construction and use of wire ropeways, slides, chutes, inclined tramways, the construction of forest roads and bridging, the building of all classes of forest rest houses, sawmills, and finally extraction work in Indian forests It would be possible to write a volume on any one of these subjects, and therefore the author has had of necessity to deal with each subject somewhat briefly His personal experience of forest engineering in many parts of the world, and especially in Canada and Africa, has enabled him to bring out clearly the important points requiring special attention by young forest engineers confronted with the everyday problems they have to solve, in those forests of the Empire which at present are not under intensive working Much sound advice is given on camping in unhealthy forests, on the choice of camping grounds, and precautions necessary when camping in both temperate and tropical climates A small omission is made when dealing with methods of transport in India, as no mention is made of the bullock cart, while the elephant is omitted as a drag animal in the chapter dealing with felling and clearing forests, though mentioned in the last chapter

Surveying, clearing streams, and log transport is briefly dealt with, though the reader may feel the need of diagrams to enable him to picture clearly in his mind the different types of skids and sledges in use Wire ropeways are dealt with in some detail, and necessarily so, as they form an important means of exploiting logs in such areas wher extensive concentrated fellings are undertaken, as is the case in Canada and the United States of America

The chapters dealing with slides, chutes, inclined tramways, roads, and trestle bridges are perhaps the most instructive and useful The types of each class are dealt with lucidly and clearly, the subject matter being sufficiently well illustrated by photographs and diagrams to enable a forest engineer to select and construct the type most suited to the individual extraction problem before him Considerable space is given to forest railways and water transport, based chiefly on work in Canadian and North American forests, the value of these chapters, and especially that on floating, would have been enhanced by descriptions and illustrations of similar work in other parts of the world "Permanent Buildings" is perhaps not a quite correct heading for Chapter xi, which also deals extensively with grass huts and similar temporary erections as used in central Africa, this in no way detracts from the value of the subject matter The work ends with a brief chapter on forest operations

in India The author describes camping as luxurious, which is undoubtedly the case in certain provinces, but very much the reverse in others

The subject as dealt with clearly denotes Mr Stewart's wide practical experience, as the information that matters when having to carry out work of this character in the forest is dealt with in such a manner as will assist the young engineer, this being so, it is the information necessary to impart to the student The illustrations are profuse and good, making with the subject matter a valuable addition to the literature on forest engineering and extraction

Modern Physics

Introduction to Modern Physics By Prof F K Richtmyer Pp xv + 596 (New York McGraw Hill Book Co, Inc, London McGraw Hill Publishing Co, Ltd, 1928) 25s net

THERE is a distinct tendency in recent American text books for the authors to expound the subject matter of physics as if their books were intended to appeal to readers whose professional interests are not very closely allied to their progress in physics Prof Richtmyer's book may show some traces of this tendency, but it is undoubtedly intended for readers who are keenly interested in modern physics, although his delightfully clear introduction to the subject will certainly introduce him to a very wide circle of readers In fact, his book is one of the most valuable of the contributions to the literature of physics which American writers have made

Although the work is termed an introduction to modern physics, it is more strictly speaking an introduction to modern physical theories, and the author has selected for examination some of the more important classical concepts as well as the modern concepts of physics, in order to give his readers a correct perspective of the growth and the more recent development of the subject as a whole He has consequently omitted a description of certain important branches of modern physics, such as thermionic phenomena, from his work, and has only briefly mentioned certain other important branches, such as the conduction of electricity through gases Yet his very sound and thorough exposition of the chosen branches is undoubtedly of much greater value to us than any skeleton key or guide to the study of modern physics could possibly be, and he is able to achieve the desired object of outlining the origin, development, and present state of those two mighty, outstanding problems of modern physics, the reconciliation of the quantum and wave theories of light and the structure of matter It is, however, a matter of regret that he has not taken the opportunity to present us with a simple outline of the conceptions recently introduced by wave mechanics

Prof Richtmyer opens with a historical sketch, dividing the history of physics into four periods, namely, the period from earliest times to A D 1550, in which experiment was absent, the period from A D 1550 to 1800, in which experimental methods of scientific inquiry were established, the period A D 1800 to 1890, in which those portions of physics which we term classical physics were developed, and lastly, the period dating from the discovery of the photoelectric effect in 1887 to the present day There is nothing particularly exciting or original about this historical sketch, it is merely a very useful form of introduction which finds a definite place in a book of this type The author then devotes a chapter to the electromagnetic theory of light, in which Maxwell's equations are developed, and it is shown that the theory requires that an accelerated electric charge should always radiate energy, the wave front being continuous Then follows a chapter on the theorems concerning the radiation from moving charges The fifth chapter deals with the photoelectric effect, and is noteworthy for the clear way in which the possible explanations of the effect are discussed, the author indicating the difficulties confronting the wave theory and pointing out that, all the same, we have to rely on the wave theory to give us the energy value of a quantum

The study of black body radiation and the origin of the quantum theory is excellently outlined in the sixth chapter, which is followed by a discussion of the quantum theory of specific heats, wherein Debye's theory is described at length and the reader referred to other works for the theories of Born and Kármán, etc Incidentally, detailed references to special treatises and original papers are lavishly distributed in footnotes throughout the book The ninth chapter, on series in line spectra, forms a very satisfactory introduction to the subject The notation given by Fowler is used for the purposes of this preliminary discussion, but in the following chapter, on the nuclear atom and the origin of spectral lines, the notation of Russell and Saunders is adopted to deal with inner quantum numbers These two chapters are likely to be much appreciated by students

Some attention is devoted to the consideration of the static atom in the eleventh chapter, preceding a

discussion of the problem of the distribution of electrons in atomic orbits and the spectroscopic method of solution of the problem The twelfth chapter is a very fine and up to date survey of our knowledge concerning X rays Finally, in the last chapter the problems of the nucleus are briefly reviewed, and here, in order to appreciate the care with which the book has been written, the reader may be recommended to consider the simple diagram of the magnetic deflection of α, β, and γ rays and to compare it with the diagrams given in other textbooks Among the appendices is a table showing the distribution of electrons in atomic orbits, according to Foote, and a table of important physical constants, and an efficient index is provided

The book is excellently printed and illustrated, and Prof Richtmyer is to be congratulated upon the appearance of a useful work which may be confidently recommended to teacher and student alike L F B

British Myrmecophilous Insects

The Guests of British Ants their Habits and Life Histories By H St J K Donisthorpe Pp xxiii + 244 + 16 plates (London George Routledge and Sons, Ltd , 1927) 18s net

ONE of the most interesting and remarkable features of the biology of social insects is betrayed in the relationships they maintain with other animals living in association with them A very large number of the latter creatures are myrmecophiles or ant guests and the majority of them are insects Although British ants number only 35 species, many times that number of myrmecophiles are known to live in a more or less definite biological relationship with them In some cases they are extranidal, or in other words, the ants seek out their myrmecophiles, while in others they are intranidal, the ants being passive and are sought out by their guests Mr Donisthorpe's enthusiasm and energy have enabled him to add 146 species to the myrmecophilous fauna of Great Britain, of which no less than 70 were new to science at the time of their discovery His intimate knowledge of this subject has enabled him to produce a book that will long remain a standard work

The volume is arranged so that each order or group of myrmecophiles is dealt with in a chapter of its own The Coleoptera are by far the most numerous in point of species and, since they are a favourite order with the author, are discussed at length Five British species are true guests or symphiles, which are tended and often fed and licked by their ant hosts The largest number, however, are synoeketes or forms which are indifferently tolerated within the nest they are represented by members of nine families of beetles, the majority being Staphylinidæ A small number of species of the latter family are synechthrans, which are hostile in behaviour, forcing themselves on their hosts and usually devouring them or their offspring

In the chapter on Hymenoptera the relations which ants exhibit with members of their own or of different species are discussed, while the various kinds of Parasitica found within the confines of the nests are enumerated We know less concerning these than almost any other group of myrmecophiles some are unquestionably parasitic upon ants, a larger number probably parasitise various other myrmecophiles, but with regard to the majority, little beyond conjectural remarks can be made, and they offer a promising field for exploration by a skilled observer

In the short but interesting chapter on Lepidoptera, five species of moths are regarded as synoeketes which live within the nest in the rôle of scavengers The relations between ants and certain Lycænid caterpillars are largely extranidal, the ants seeking out such larvæ wherever they are feeding in order to imbibe their glandular secretions In the case of *Lycæna arion*, the larva, when in its fourth instar, is carried by ants into the nest, notwithstanding the fact that it lives at the expense of their own larvæ Other chapters are concerned with Diptera, Hemiptera (three chapters), Acarina, Isopoda, etc , and the book concludes with a bibliography and both authors and species indexes A D IMMS

Our Bookshelf

(1) *Comparative Physiology of the Heart* By Prof. A J Clark (Cambridge Comparative Physiology Series) Pp vi + 157 8s 6d net
(2) *The Comparative Physiology of Internal Secretion* By Prof Lancelot T Hogben (Cambridge Comparative Physiology Series) Pp vii + 148 10s 6d net
(3) *Ciliary Movement* By J Gray (Cambridge Comparative Physiology Series) Pp viii + 162 10s 6d net
(Cambridge At the University Press, 1927 and 1928)

HUMAN physiology will ever continue to be the science which will pre-eminently fascinate the mind of man in virtue of the directness and personal character of its appeal The versatility of man, which has placed less resourceful creatures under his dominion, has also led to the combination of so many physiological processes in a single species that it is not surprising that several of these processes,

considered individually, may be found more highly developed in lower species For the better understanding and for the more thorough investigation of such living processes, recourse must be had to animals in which the particular mechanism under consideration is most highly typified It is just here that the Cambridge series of Monographs on Comparative Physiology brings the student or worker in physiology into touch with the evolution, the variety, and what might perhaps be regarded by him as the exaggeration of normal human processes

(1) The heart is the organ which has always attracted the attention of human beings from the remotest ages, and it is fitting that a volume should be devoted to this organ, giving in this case some qualitative and many quantitative characteristics of species differing widely in their normal activities

(2) The discovery of internal secretions is so recent and so largely based on a study of the higher vertebrates, that a volume putting forward the present state of knowledge regarding the invertebrates as well is useful not only in making possible wider generalisations, but also in providing new material of a simpler type for further investigation

(3) The volume on ciliary movement deals with a subject which, in virtue of its complete overshadowing by muscular movement, is only very briefly referred to in text books on human physiology, its study is best carried out in those organisms depending wholly on ciliary movement for locomotion, muscular movement being non existent, only in this way can the various hydrodynamical problems be investigated

All three volumes present the matter in a readable manner with well chosen diagrams, and will prove of interest to the student of general physiology as well as to the physiological investigator

(1) *In the Beginning the Origin of Civilisation* By Prof G Elliot Smith (The Beginning of Things Series) Pp vi + 90 (London Gerald Howe, Ltd, 1928) 2*s* 6*d* net

(2) *The Origins of Agriculture* By Harold Peake (Benn's Sixpenny Library, No 6) Pp 78 (London Ernest Benn, Ltd, 1928) 6*d*

(1) PROF ELLIOT SMITH'S little book, though not the first in order of publication, is the introductory volume in the series "The Beginning of Things" In his prefatory remarks he explains that the object of the series is the publication of a number of volumes, each dealing with some aspect of culture from a common point of view What this point of view is, it is the purpose of the introductory volume to demonstrate

Here we have Prof Elliot Smith at his best So far as the theoretical side goes, he has given us no more lucid and logically argued statement of the case for his views on the diffusion of culture and its origin in Egypt Although he is careful to point out that the pursuit of any single line of investigation such as the origin of agriculture or of metal working leads to disaster, virtually his case rests upon the first cultivation of barley in Egypt

(2) Mr Peake, in his brilliant little study of the origin of agriculture, of which the size and the popular form of publication are no criterion of the importance, is directly at odds with Prof Elliot Smith He has collected carefully all the evidence bearing upon the origin of the different kinds of grain After a judicial survey, his conclusion is on the whole against Egypt and turns rather to northern Syria Apart from this question, Mr Peake's book gives an admirably reasoned account of the prehistoric conditions of life in which agriculture must have originated

Where are the Dead? Pp ix + 136 + xi (London, Toronto, Melbourne and Sydney Cassell and Co, Ltd, 1928) 3*s* 6*d* net

THIS volume comprises a collection of articles by a wide variety of writers upon the subject of human immortality, contributed to the *Daily News* Undoubtedly the most interesting of those to students of science will be the contributions of Sir Arthur Keith and Prof Julian Huxley, since these contain a concise and clear statement of views widely held in scientific circles It is probable that the importance for religion of either positive or negative views on this subject has been exaggerated

Sir Arthur Keith rightly says that "If the spirit of truth is the kernel of religion, then men of science are truly religious beings" He might have added that absorption in disinterested research is one of the modern spiritual equivalents for religious asceticism At the same time, students of science should not overlook the significance of a point of view such as that expressed with great ability in the contribution by Mr Hugh Walpole, which strikes us as in some ways the best thing in the book Whilst the others, orthodox and unorthodox alike, are all more or less obsessed with the distinction between body and mind (even when they reduce these to common terms), Mr Walpole sees that the only important distinction is that between the elements in our experience which are exactly measurable, and those which are not The important thing about man is not that he has, or has not, a 'soul,' but that "out of such a midget there have proceeded the spiritual greatness of Hamlet, the magnificence of the Fifth Symphony, the glorious simplicity of St Francis " J C H

Factors affecting the Distribution of Electrolytes, Water, and Gases in the Animal Body Lectures delivered at Rutgers University under the Luther Laflin Kellogg Foundation By Dr Donald D Van Slyke (Monographs on Experimental Biology) Pp vii + 62 (Philadelphia and London J B Lippincott Co, n d) 10*s* 6*d* net

THE title of this little monograph may alarm those who are not gifted with a taste for mathematics, but its perusal leaves only a feeling of admiration for the manner in which the author has presented his subject An examination of the degree to which the distribution of electrolytes, water, and gases in the body obeys the laws of physics and chemistry necessitates the use of a certain amount of mathematics, but the presentation is so clear

that even the average student should be able to follow it with ease The subject matter forms a useful exposition of the way in which physico-chemical theory can be applied to the prediction of biological phenomena, as well as the necessity, in considering such phenomena, of using the methods of synthesis in addition to those of analysis, if a true idea of their influence upon each other in the living intact organism is to be attained Among the subjects dealt with are the functions of hæmoglobin and the mechanisms of the production of œdema A selected bibliography is appended For its size, the price seems somewhat high, but the monograph is well worth reading by all interested in this subject

Aspects actuels de la physiologie du Myocarde (Première série) *L'onde d'excitation motrice, son origine, sa propagation, ses manifestations électriques* Par Prof Henri Frédéricq (Les problèmes biologiques, Tome 7) Pp viii + 300 (Paris Les Presses universitaires de France, 1927) n p

THIS is the seventh volume to appear in the collection of monographs on biological problems issued under the guidance of a technical committee comprising some of the best known names in French biological science The preceding volumes have, in the main, dealt with physico chemical and embryological subjects, with the exception of Lapicque's important monograph on a subject which, like the volume under review, is more directly physiological The author has collected together a considerable amount of data of a representative character and he has moulded it into an orderly review of the present state of knowledge with regard to these properties of the myocardium, while each chapter is rounded off with a useful summary The book should make an appeal to students of physiology and also to medical practitioners, since the subject matter is concerned chiefly with the mammalian heart

Macedonian Imperialism and the Hellenization of the East By Prof Pierre Jouguet Translated by M R Dobie (The History of Civilization Series) Pp xx + 440 + 7 plates + 4 maps (London Kegan Paul, Trench and Co, Ltd, New York Alfred Knopf, 1928) 21*s* net

THE keynote of this volume is the imposition of political unity on the "small collective individualities" of which the rise has been described in the earlier volumes of the Greek series, and the demonstration of how the common civilisation, which had hitherto been their bond, was affected by an external force which in its origin at least was alien to Hellenism The hero of the epic, for it is nothing less, is necessarily Alexander, and of him Prof Jouguet has made a truly epic figure He sees in him intensity of character, power of imagination and thought, fortified by literature and philosophy His qualities were accompanied by an extraordinary clearness of mind in carrying out his projects The weaknesses of Alexander may lead one to question the true character of his idealism, but of his genius there can be no doubt To this Prof Jouguet does full justice, without attempting to disguise the flaws in his organisation, which led to the break up of the Empire In dealing with the later period, the author's very careful study of Egyptian conditions especially calls for commendation

Raw Materials of Commerce By J Henry Vanstone, assisted by Specialist Contributors Complete in about 24 Fortnightly Parts Part 1 Pp ii + 32 (London Sir Isaac Pitman and Sons, Ltd, 1929) 1*s* 3*d* net each part

THIS work is planned to give accurate and modern information about the raw materials of industry It is to be divided into four sections, covering vegetable, animal, mineral, and synthetic products respectively The contents gives the impression of a comprehensive work which should be of considerable value to students of geography, economics, and commerce, as well as to persons actually engaged in manufactures The first part, in addition to the introduction, has articles on fibres generally, cotton, flax, and jute Each article describes the plant concerned, conditions of cultivation, harvesting, and the preparation and marketing of the fibre The author has succeeded in combining accuracy with the avoidance of unduly technical language Much of the matter is not otherwise readily accessible except in expensive works dealing with one or other industry, or is scattered in technical journals The work is well illustrated by photographs, maps, and coloured plates

Principles and Applications of Electro Chemistry By Prof H Jermain Creighton Second edition, revised and enlarged In 2 volumes Vol 1 *Principles* Pp xvi + 488 (New York John Wiley and Sons, Inc, London Chapman and Hall, Ltd, 1928) 20*s* net

THE first volume of Creighton and Fink's book on "The Principles and Applications of Electro-chemistry," dealing with principles, has reached a second edition before the second volume, dealing with applications, has appeared The second edition includes new chapters on "The Activity of Strong Electrolytes" and on "Theories of Strong Electrolytes," but the author has postponed the drastic operation of making the rest of the volume conform to the theory of complete ionisation

Lehrbuch der physikalischen Chemie Von Prof Dr Karl Jellinek Fünf Bände Zweite, vollständig umgearbeitete Auflage Band 2 *Die Lehre vom festen Aggregatzustand reiner Stoffe, Die Lehre von den verdünnten Lösungen* Lieferung 5 Pp 273 560 24 gold marks Lieferung 6 Pp xiv + 559 924 32 gold marks Band 2 vollständig 88 gold marks (Stuttgart Ferdinand Enke, 1928)

THE two sections now received complete the second volume of Prof Jellinek's text-book, of which the first volume and the initial section of the second volume were recently noticed in these columns (Oct 6, 1928, p 523)

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications]*

Observations of Luminosity of the Night Sky

WE have now observed the luminosity of the night sky for three years at the Commonwealth Solar Observatory, using photometers kindly supplied by Lord Rayleigh These measure the absolute intensities of three regions of the spectrum—the red, a patch of green which includes the auroral line, and the blue

If it is legitimate to assume that the transmission through the red filter is free from auroral radiation, or at least that the latter is not important compared with the amount of continuous radiation which passes through it, it is possible to devise a method for eliminating all, or at any rate the bulk, of the continuous radiation superimposed upon that which is localised in particular regions of the spectrum For this purpose it is only necessary to observe the sunlit sky or the moon through the photometer when the incident light has been reduced in strength to the scale of night sky intensities, this must be done in such a way that its quality is unchanged Corresponding readings are then made of the transmissions through the three filters over the range usually encountered, from these, graphs are drawn relating the green and blue readings with those made through the red filter

We are thus enabled to find the amount of green radiation associated with the continuous spectrum for any observed red reading, we subtract it from the radiation observed through the green and blue filters, thus obtaining the green and blue transmissions presumably free from the background of white light By confining our attention to nights free from haze, we hope to avoid trouble from selective scattering at the red and blue ends of the spectrum For similar reasons we avoid times when the sun or moon is near the horizon A considerable amount of green auroral radiation remains, and its fluctuations may be traced throughout the year Maxima tend to occur in April–May and October–November In 1926 the former, and in 1927 the latter, was the more pronounced In the present year the April maximum was very marked, but the November readings now in progress are on some nights exceptionally large

The true auroral blue component fluctuates in a somewhat similar way but with a smaller amplitude It is probably absent altogether at certain seasons There is high correlation between the blue and auroral green values about April and November, with low values at other times Lord Rayleigh's suggested division of auroræ into two types, polar and non polar, is supported, it is suggested that the occurrence of faint auroral illumination of the polar type is responsible for the high correlation in April and November, probably through the excitation of nitrogen bands At other times of the year the auroral green radiation appears to be the sole characteristic of the non polar type

It seems likely that some considerable portion of the differences noted by Lord Rayleigh at different stations on the same night are due to the admixture of continuous spectrum As the accompanying table shows, the elimination of the continuous spectrum usually reduces the differences considerably, the first five columns are reproduced from Lord Rayleigh's paper (*Proc Roy Soc*, A, 119, p 23, 1928)

Date	Place	Observed			Reduced		Differences				Remarks
		Red	Auroral	Blue	Auroral A	Blue* B	Auroral Observed	Auroral Reduced	Blue Observed	Blue Reduced	
Jan 16, 1926	England	- 4 4	- 1 4	+ 5 8	2 6	1 7	3 4	0 8	3 2	0 8	Reduced values show improved agreement (Canberra values $A=3\ 3$ $B=2\ 8$ agree well with Cape)
	Cape	- 1 0	+ 2 0	+ 9 0	3 4	2 5					
Mar 2, 1926	England	- 3 6	- 0·2	+ 6 4	3 0	1 5	2 2	- 1 2	1 3	- 1 8	Difference persists (No Canberra readings, moon nearly full)
	Cape	- 0·4	+ 2 0	+ 7 7	1 9	0 3					
April 15, 1926	England	- 3 6	- 0·8	+ 6 4	2 4	1 5	3 2	1 9	1 9	0·7	Outstanding auroral difference probably due to auroral display in S latitudes (Canberra reduced values $A=4\ 0$ $B=2\ 8$, agree well with Cape)
	Cape	- 2 4	+ 2 4	+ 8 3	4 3	2 2					
Sept 19, 1925	Shetland (Lerwick)	- 4 4	- 2 8	+ 3 4	1 2	- 0 7	4 ,	3 7	3 0	2 2	Differences persist Lerwick's readings outside range of experience at Canberra
	England (Northumberland)	- 3 6	+ 1 7	+ 6 4	4 9	1 5					
June 7, 1926	Hawaii	- 4 7	- 0 9	+ 5 1	3 5	1 3	3 0	0 6	2 8	0·5	Reduced values show improved agreement
	Canberra	- 2 4	+ 2 1	+ 7 9	4 0	1 8					

As Lord Rayleigh selected these pairs to emphasise the contrast between readings at different stations, it is likely that the bulk of the readings will not differ by nearly such large amounts after reduction We have assumed that the instruments used elsewhere possess precisely the same qualities as ours and have used our own graphs for their reduction, but it would be an improvement, of course, to determine the correction curves separately for each instrument, *in situ*

The nature of the continuous spectrum is itself of interest From the parallelism between the distribution of energy in the night sky and the sunlit sky or moonlight, we look at once for an explanation on the ground of the diffusion of sunlight or moonlight, though the rotundity of the earth makes this difficult to picture At the same time, we cannot overlook the possibility that this faint white radiation may

arise from some new form of auroral excitation originating perhaps outside the earth's shadow, or to the recombination of ions which had previously been separated

The annual period is pronounced, the maximum with us occurring in May or June of each year This suggests its association with the phenomenon known as the 'Gegenschein,' because it is at this season of the year that the sun is most nearly opposite the place of observation

On some nights the sky appears to be of great brilliance The outstanding feature is the smallness of the transmission through the red filter The auroral green radiation is then relatively bright, but not absolutely large The main criterion for a brilliant sky is thus the absence of a continuous spectrum

A memoir embodying the observations made at Mount Stromlo in 1926 and 1927, together with a detailed account of the method of reduction outlined above, is in the printer's hands and will shortly be available for distribution W G DUFFIELD

Commonwealth Solar Observatory,
Mount Stromlo, Canberra,
Australia, Nov 11

The Electromagnetic Equations in the Quantum Theory

IN spite of the great progress made in recent years, the theory of radiation is still in rather an unsatisfactory state By the methods of Schrödinger it is possible to express the radiation of atoms in the form of electromagnetic waves, but the formulation is quite incomplete, because it fails to give the reaction of the radiation on the emitting system The theory of Dirac (*Proc Roy Soc*, **114**, p 243) is free from this cardinal fault, but fails to show the relation of radiation to static electric force, it is in fact a valid theory of light, but scarcely an electromagnetic theory It is of course quite probable that in a complete theory there is no need, or room, for radiation at all, in that the direct interactions of particles according to relativity principles will give all that is required, but radiation must always remain a convenient eliminant, expressive of the effect of a number of particles on a distant one So it seems not out of place to fit the electromagnetic equations into the general scheme, if they are wrong, it is still interesting to know why Maxwell made the mistake of inventing them !

The following considerations suggest in a natural way how the equations arise Although by Schrödinger's method it is possible to calculate the radiation scattered in the Compton effect yet the method is incompetent even to express the idea embodied in the celebrated experiment of Geiger and Bothe (*Zeit für Phys*, **32**, p 639), in which it was observed that the directions of scattering of electron and light quantum were absolutely correlated The simplest way of making it possible to express such an idea is to endow the light with a set of co ordinates X, Y, Z, T, and to have a wave function simultaneously involving both these and the x, y, z, t of the electron Some such idea is also directly suggested by Dirac's theory, though he makes no use of actual co ordinates

The equation determining the behaviour of an electron in a field of radiation is, according to Dirac (*Proc Roy Soc*, **117**, p 610),

$$(p_0 + \alpha_1 p_1 + \alpha_2 p_2 + \alpha_3 p_3 + \alpha_4 mc)\psi = 0$$

Here the α's are certain four rowed matrices, and p_1 stands for $\frac{h}{2\pi i}\frac{\partial}{\partial x} + \frac{e}{c}V_1$, where V_1 is the first component of vector potential, while similar meanings connect p_2, p_3, p_0 with y, z, t Now $\frac{h}{2\pi i}\frac{\partial}{\partial x}$ is symbolically the momentum of the electron, and it is therefore natural to regard eV_1/c as the momentum of the radiation The equation then expresses the constancy of momentum in the interaction, and this is just what is used in working out the Compton effect by elementary principles It is only a step to replace eV_1/c by $\frac{h}{2\pi i}\frac{\partial}{\partial X}$ as the symbolic momentum of the radiation If now we have a field of radiation far away from the electron, the solution must split into two independent factors, and the radiation by itself will satisfy the equation

$$\left(-\frac{1}{c}\frac{\partial}{\partial T} + \alpha_1\frac{\partial}{\partial X} + \alpha_2\frac{\partial}{\partial Y} + \alpha_3\frac{\partial}{\partial Z}\right)\psi = 0$$

When the values of the matrices are substituted, this equation is replaced by four which are exactly Maxwell's equations for free space, combined according to the rules

$$\psi_1 = -iH_z,\ \psi_2 = H_y - iH_x,\ \psi_3 = E_z,\ \psi_4 = E_x + iE_y$$

The only difference is that E and H must be real, whereas the ψ's are usually complex In a recent paper (*Proc Roy Soc*, **120**, p 621) I pointed out this similarity, but at the time was unable to explain it

This is, of course, only the germ of the matter, and it leaves many difficulties unsolved Thus it will be immediately asked how the potentials V, which started as coefficients multiplying ψ, can be derived from part of the solution for ψ itself The only answer that can be given is that the same sort of change occurs in other parts of the wave theory, when the reaction on a perturbing system is neglected It will certainly be necessary to replace the term mc by some function of the co ordinates and, among other things, this should lead to an analogue to the classical calculation of electromagnetic mass, but to carry the matter further raises a very fundamental difficulty which I cannot overcome We have not only two superposed *spaces*, but also two superposed *times*, and this is an idea that is very difficult to apprehend, for it so to speak, dislocates the whole process This difficulty is not special to the present work, but inevitably occurs in any relativistic representation of more than one particle Since it may be some time (or should it now be *times* !) before this trouble is overcome, I have been emboldened to write the present communication, showing the outline of how we may hope that the old waves can be fitted, almost without change, into the new scheme C G DARWIN

The University, Edinburgh,
Jan 17

The Absorption of X-Rays

THE atomic X ray absorption coefficients of the elements have commonly been represented by simple formulæ of the type $\tau_a = kZ^x\lambda^y$ (k a factor involving fundamental atomic constants, Z the atomic number of the absorbing element, λ the wave length of the X rays, x and y exponents not very different from 4 and 3 respectively) These formulæ have been derived in a variety of ways (J J Thomson, A H Compton, L de Broglie, H A Kramers), and the complete expression for the absorption coefficient of an element over all ranges of X ray wave lengths has been represented as the sum of a number of such terms—each term corresponding to the fluorescent excitation of a distinct series or sub series (K,L_1,   ), and dropping out for wave lengths longer than that of the corresponding absorption edge Experimental determinations of the absorption coefficients have shown fair agreement with theory, both with respect to the general run of the coefficients on each side of a discontinuity, and to the magnitudes of the discontinuities

In spite of this approximate agreement, it has become increasingly clear that the simplicity of the formulæ in no way reflects a corresponding simplicity in the absorption process There is very complete evidence (Robinson, Skinner) that the 'partial' absorptions of the individual electronic groups and sub groups vary with λ in a much more complicated manner than is suggested either by the older absorption theories or by the measurements The close adherence of the measured absorption coefficients, over wide ranges of wave length, to the 'λ^3 rule' (Richtmyer's precision measurements)—or to the similar rules with slightly different exponents, favoured by Allen and others—must therefore be regarded as a statistical effect due to mutually compensating variations in the partial absorptions

Most of the available data have been fully discussed (notably by Richtmyer and Compton) in relation to the older absorption theories Newer theories (Wentzel, Oppenheimer) lead to more complicated formulæ which allow for the above mentioned deviations of the partial absorptions from the λ^3 rule Unfortunately, these formulæ cannot yet be implemented in a sufficiently precise numerical sense, and further experimental data are urgently needed

It may perhaps be stressed here that the direct measurement of absorption coefficients can contribute relatively little evidence to some of the points at issue The contributions of (say) the L electrons to the total absorption for wave lengths shorter than that of the K discontinuity can, it is true be deduced from the absorption curves, but only by the most intrepid extrapolation, and although the measurements have been conducted with the utmost skill by a number of workers, there remain some obvious and (Bothe) other less obvious difficulties of interpretation, linked with uncertainties in the allowance to be made for the effects of scattering

It has long been realised that the 'magnetic spectrometry' of the secondary cathode rays from the absorber can provide valuable evidence, supplementary to that of the absorption measurements The method is particularly suitable for comparing (say) the absorptions of the L electrons of a heavy atom and the K electrons of a lighter atom—the atoms being so selected that the secondary electrons emerge with similar energies in the two cases (allowing only a sufficient difference for the clear resolution of the two sets)

We are now carrying out experiments on these lines With absorbers compounded or mixed with the two elements in suitable proportions, a single experiment is often sufficient to fix approximately the relative absorptions of the two sets of levels in question We find, for example, that the two K electrons of a zinc atom absorb probably more—and almost certainly not less—X radiation of wave length 0 56 A than the eight L electrons of tungsten

According to one empirical absorption law, the tungsten L electrons should absorb 4 8 times as strongly as the zinc K electrons According to de Broglie's theory, which (Richtmyer) gives in many respects excellent agreement with the measurements, this ratio should be 5 2 An extension of Kramers' theory, which attaches diminished weights to electrons in 'orbits' of higher quantum numbers, partially, but insufficiently, reduces the discrepancy On the other hand, Kramers' theory fits many of the direct absorption measurements less well than that of de Broglie In any case, all theories so far proposed contain necessary simplifying assumptions which could account for deviations of the kind observed, and it would be unprofitable further to discuss them here

The purpose of this note is simply to point out some of the difficulties of the problem, and to indicate the nature of some of the points on which we hope to bring more detailed information The method of corpuscular spectrometry, while limited in some of its applications, is unusually flexible in other directions This flexibility imposes an obligation to extend the measurements over a wide range of X ray levels, and with a wide range of primary radiations—especially in certain important regions The preliminary stages of the work have been unduly protracted by exceptional local conditions, but we now hope to proceed comparatively rapidly with the full programme—although at best the investigation will be a lengthy one

The work has been assisted by a grant to one of us (H R R) from the Government Grant Committee of the Royal Society, for which we here desire to make acknowledgment

H R ROBINSON
C L YOUNG

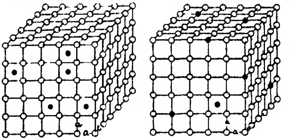
University College,
Cardiff, Jan 10

The Nature of Martensite

DURING the past few years several papers have been published on the nature of changes in carbon steel during the processes of quenching and tempering

The dilatometric investigations of Haneman and Traeger [1] have shown that during the process of tempering of quenched steel there exist three transition points 100°, 235°, and 300° The X ray study has shown that tetragonal martensite disappears at 100° C The second transition point (235°) on the Haneman's and Traeger's curve, also confirmed by X ray investigations, is the temperature of transformation of austenite At 300°, iron carbide, Fe_3C, is formed

According to Honda's theory, the first transition point (100°) is accounted for by the transformation



a b
FIG 1

of the tetragonal lattice of the martensite into a cubic one, and we think that the arrangement of the carbon atoms in these two forms of martensite is the following —

In tetragonal martensite the positions of the carbon atoms are definite, and they are situated at the centres of those faces which are perpendicular to the tetragonal axe (see Fig 1a)

In cubical martensite the positions of the carbon atoms are not fixed Some of them replace the iron atoms in the lattice, and some are situated at the centres of the faces (Fig 1b) Any assumption that all carbon atoms should be situated at the centres of the faces would give a density considerably higher than is obtained experimentally

Kurdumow and Kaminsky [2] have shown that the ratio of the axes of the lattice of the tetragonal martensite increases with the increase of the carbon

[1] Haneman and Traeger *St und Eisen* p 1508, 1926.
[2] G Kurdumoff and E Kaminsky NATURE Sept 29, 1928.

contents in steel Honda and Sekito,[3] however, have obtained from their experiments that the value of this ratio is independent of the contents of carbon, and that the ratio is equal to 1 07

This result of Honda and Sekito is contrary to the well known fact of the diminution of volume change of quenched steel with decrease of carbon contents From Honda and Sekito s data we can conclude that in quenched steel with carbon content 0 2 per cent, the volume of tetragonal elementary cell is 5 per cent larger than the volume of an elementary cell of α iron This is entirely contradictory to results of Matsushita[4] and Birnbaum,[5] who investigated the changes of volume of steel with small contents of carbon during the process of tempering Matsushita and Birnbaum were also unable to obtain a transition point near 100° for steels with carbon content 0 2 per cent

Prof Honda has kindly informed me by letter of certain details of his and Sekito's experiments According to that letter 'Sekito placed the specimen in a porcelain tube, one end closed, packed with char coal powder, and heated it in an electric furnace In such conditions, surface cementation might take place, and that would give equal values for the ratio of axes for tetragonal martensite in specimens of steel with different contents of carbon In fact, the constant values for the ratio of axes obtained by Honda and Sekito probably mean that the content of carbon in the surface layers was the same in all cases

The broadening of the spectral lines in the case of martensite, Honda and Sekito explain by the presence of the carbon atoms in the lattice The presence of a carbon atoms changes the dimensions of the cells which they occupy, and exerts an influence on the dimensions of the surrounding cells, giving an irregularity in the lattice

We entirely agree that such irregularity of the lattice is very probable in the case of martensite

Now Debye[6] has shown that the heat movements of atoms in the lattice produce a decrease in the intensity of the spectral lines In martensite, therefore, in this solid solution, the irregularities in the positions of the solvent atoms produced by the solute atoms give a continuous variation of the lattice parameter, and therefore also cause only a decrease in the intensity of the spectral lines, but not the broadening of them

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[3] K Honda and S Sekito *Sc Rep Tôhoku Imp Univers* 17
[4] Matsushita *Sc Rep Tôhoku Univ* 7, 43-52, 1918
[5] Birnbaum *Archiv für Eisenhut*, Heft 1 Juli, 1928
[6] P Debye. *An d. Physik*, 43, p 49, 1914.

Raman Effect in Gases

SINCE the discovery of the Raman effect in scattered light, investigation has been extended to a large number of substances in the solid and liquid state So far as I know, practically nothing has been done on gases, if we except an observation on ether vapour by Ramdas Of course, the main difficulty in the case of gases consists in the extreme weakness of the scattered radiation

Using a very luminous spectrograph (aperture of camera lens 1 2 7) I have obtained plates which show Raman spectra of different gases The light source employed was a mercury arc, and the exposure time was 48 hours, using gases at atmospheric pressure The length of the spectrum on the plate was 16 mm from λ3650 to λ5461, wave lengths were measured by comparison with a copper arc spectrum

This research is being carried on, and will be extended to a larger number of gases, and, if possible, with a more dispersive apparatus But the results already obtained with carbon monoxide and carbon dioxide are perhaps worth a short notice

Carbon monoxide shows two Raman lines at about λλ4432, 4810 They correspond evidently to the same quantum transition, excited by both λ4046 and λ4358 of mercury, the differences in frequency between the Raman lines and the exciting lines are found to be respectively 2154 and 2156 cm^{-1} (the agreement being better than is to be expected with the dispersion used) and this corresponds to an infra red absorption band at 4 64 μ In fact a double band, with the centre at 4 66 μ, has been found in the absorption spectrum of carbon monoxide so that there can be scarcely any doubt about the origin of the observed Raman lines

The behaviour of carbon dioxide is quite different The infra red absorption spectrum consists mainly of three bands (each of which has a structure depending on rotation states) at 2 7 4 25, and 14 7 μ These are interpreted by C Schaefer and Philipps as being the three fundamental oscillation frequencies of the tri-atomic molecule

Now, in the Raman spectrum no lines were found corresponding to any of these absorption bands, though they would all have fallen in the region of spectrum photographed I observed instead two doublets, at λλ4639, 4616 and λλ4289 4268 excited respectively by λ4358 and λ4046 They correspond to transitions of 1284 and 1392 ($\pm$ 10) cm^{-1} which have not been observed in absorption even through very thick layers of the gas

A rather surprising coincidence appears however, if we calculate the differences in frequency between the two components of the double band at 2 7 μ and the band at 4 25 μ (which has a much smaller separation) We find the values 1279 and 1381 cm^{-1}, which agree within the limits of experimental error with the two frequencies given above

One example is not enough to prove that this coincidence has a physical meaning, but it is a remarkable fact anyhow that none of the strong absorption bands of carbon dioxide appear in Raman effect Investigation extended to other substances will show if really, for some types of molecules, not the infra red absorption frequencies themselves, but only their combinations, appear as a Raman shift in the scattered radiation

F RASETTI

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An Apparently Anomalous Raman Effect in Water

CARRELLI, Pringsheim and Rosen (*Zeits fur Physik*, **51**, 511, 1928) have shown that the Raman scattering by water molecules yields only one modified frequency, corresponding to an infra red band at 2 90μ This modified frequency has, at first appearance, two anomalous aspects (1) the modified 'line' is really a broad band of approximately 500 cm^{-1} width, in contrast to the sharpness of Raman lines produced by organic liquids, (2) no infra red band corresponds exactly with the centre of the observed scattered band, the nearest one being the strong 3 0μ infra red band

I believe that the Raman spectrum of water is not anomalous in either respect In 1927 (*Phil Mag*, **3**, 618, 1927) I presented an argument, based largely on an attempted correlation of the water bands below 3μ, in which it was pointed out that the strongest infra red band, the one at 3μ, was probably double, being made up of an overtone of the 6 1μ band and a new fundamental I tentatively assigned a wavelength value of 2 9μ to this fundamental, and believe

that it is this fundamental band which shows up in the Raman spectrum The overtone of the 6 1μ band would not be expected to appear since its fundamental does not occur This appearance in the Raman spectrum of one fundamental and the absence of a second is believed to occur analogously in the scattered spectrum of ammonia in water solution (Carrelli, Pringsheim, and Rosen, *loc cit*) and of organic liquids (Pringsheim and Rosen, *Zeits für Physik*, **50**, 741, 1928)

Again, the comparatively great breadth of the scattered water band is, after all, quite consistent with the breadth of the infra red bands of water I have measured, for example, the width of the 1 46μ water band (probably the first overtone of the 2 9μ band with possible other bands superposed) and have found it to be 800 cm $^{-1}$ wide This is somewhat broader even than the 2 9μ band found in the Raman spectrum

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A New Type of Alum

The close external crystallographic similarity between potassium sulphate and potassium beryllium fluoride, K_2BeF_4, has previously been pointed out by Fedorov and Barker Both salts crystallise in the orthorhombic system, and are pseudo hexagonal Adopting standard orientation, the respective axial elements are For K_2SO_4, a b c = 0 7418 1 0 5727, and for K_2BeF_4, a b c = 0 7395 1 0 5708 It has further been suggested that, since the salts exhibited some structural analogies as indicated by the formulæ, this external similarity might be accompanied by true physical isomorphism (The well established isomorphism in the exactly analogous series $NaNO_3$ - calcite and KBF_4 - $KClO_4$ - $BaSO_4$ is of interest in this connexion)

Further definite evidence with regard to this question has now been obtained On allowing an aqueous solution containing equimolecular quantities of potassium beryllium fluoride and aluminium sulphate to crystallise at the ordinary temperature, it was found that crystals of the composition K_2BeF_4 $Al_2(SO_4)_3$ $24H_2O$ were deposited This salt crystallises in the cubic system normally as octahedra, and is a true alum It readily forms true overgrowths on the common alums, for example, chrome alum A similar alum is obtained when potassium zinco chloride, K_2ZnCl_4, is substituted for K_2BeF_4 The existence of these alums shows clearly that potassium sulphate and potassium beryllium fluoride are truly isomorphous

Rubidium beryllium fluoride, Rb_2BeF_4, forms crystals which are isomorphous with those of the potassium salt Pseudo hexagonal interpenetration triplets are frequently formed as thin flakes In these triplets the individuals are tabular on $a(100)$, the flakes being bounded by the form $q(011)$ In many cases the form $q(011)$ is absent, and is replaced by the form $o(111)$, bevelling the flake edges The double refraction is weak and positive The optic axial plane is $b(010)$, the acute bisectrix being the a axis Exactly analogous interpenetration is characteristic of potassium sulphate, and hence this triplet formation is significant In the case of potassium sulphate, where the accurate measurements of Tutton are available, the twinning is described as taking place on a plane perpendicular, not to the actual $q(011)$ face, but to an idealised $q(011)$ face corresponding to a true hexagonal structure, *i e* twinning occurs as if the angle 011 0$\bar{1}$1 were accurately, not approximately, 60°

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The Methodology of the Inexact Sciences

The reply to my letter under the above heading (Nature, Jan 26, p 130) rather misses my point I was not discussing those points of contact between Mithraism and Christianity for which there is historic evidence, such as the ideas which Tertullian accused the former of borrowing from the latter My contention was that in the particular example which I quoted the evidence was based on the fallacy—let us call it 'philonism'—which consists in attributing undue significance to the analogies or parallels that can be drawn between every two groups of ideas

I have made the alarming discovery that you, Sir, the editor of Nature, are simply a mythical survival of Mithraic beliefs We have been accustomed to regard you as the champion of the light of science which is to prevail over the darkness of error and superstition, but this popular notion is clearly a survival of the legendary victory of Ormazd over Ahriman with which Sol Invictus Mithras was associated The astrological notions which pervaded Mithraism survive in the attribution to you of pseudepigrapha dealing with astronomical subjects and the reformed calendar which we now enjoy, and also in the design at the head of the cover of Nature But perhaps the clearest evidence for my thesis is to be found in the prominent rôle assigned to you by common rumour in the orgiastic rite known as the Feeding of the Lions, an esoteric mystery which is practised during the meetings of the British Association In this rite the spelæum of Mithras is represented by a room in a tavern, where the initiates consume with elaborate ceremony the flesh of a sacrificial bull The dog which made possible the sacrifice of the bull by Mithras is here known as the 'jackal,' the sinister activity of the scorpion is imitated by the wagging of coat tails, there are libations, and the torch bearers common on Mithraic monuments are represented by the ceremonial burning of tobacco with which the orgy concludes

At first I was unable to account for the title "The Red Lions" assumed by the initiates, and derived, according to popular tradition, from the public house in which their first meeting was held On referring to an authority, however, I find that "Lion" was the title assumed by devotees of Mithraism on reaching full initiation It was not until he had passed through the degrees of Corax, Cryphius, and Miles that the initiate might attain to that of Leo, which entitled him to full participation in Mithraic mysteries The crudeness of the popular story about the Red Lion public house at Birmingham is thus only too apparent

With this horrible example before me I do feel that the study of comparative religion ought to be purged of the philonistic fallacy The other science in which that fallacy mainly occurs—namely, analytical psychology—is past praying for in the Mithraic or any other liturgy

C W Hume

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Dr J W L Glaisher

Will you allow me to add a few points supplementary to the very full obituary notice of the late Dr Glaisher, which appeared in Nature of Jan 26 One outstanding trait of his character was his extreme accuracy, which often made him undertake a journey to London to settle a minor historical or bibliographical point by referring to the actual books, when only quotations or copies of titles were available to him His "Report on Mathematical Tables" (1873) perhaps best illustrates this characteristic The Report is marvellously complete, and it would be very difficult to discover a mistake in it Those who

have undertaken work of this kind will understand the difficulty of producing such a flawless work

Besides pottery, Dr Glaisher also collected arithmetical books of the fifteenth and sixteenth centuries, and his collection is probably the most complete one in private possession in Great Britain Dr Glaisher, however, was no mere book collector, but read all his books (whatever the language), and to good purpose, as his articles in the *Messenger of Mathematics* amply show One of these, "On the Early History of the Signs + and −, and on the Early German Arithmeticians" (1921–22), will prove a mine of information to historians of mathematics, who cannot possibly read all the books themselves Dr Glaisher had a keen sense of humour, which enabled him to enjoy the human interest found even in such supposedly dry books, and he would often express his amusement of the various questions and problems abounding in the works of Adam Riese and Stifel His collection of mathematical books, as he informed me, he bequeathed to the library of his college

This did not exhaust Dr Glaisher's activity as a collector Two other collections he formed and prized, both very far afield from the realms of science, but characteristic as showing his varied human interests One was of children's books with movable figures, and the other (a very complete one) of valentines But whether these also were left to Trinity College, Cambridge, I do not know

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Stellar Spectra in the Far Ultra-Violet

IN a letter to NATURE of Nov 24, 1928, Cario suggested that in the region of arctic winter night the 3000 A barrier of stellar spectroscopy may be absent, leaving a clear view down to 2100 A, where absorption by ordinary oxygen molecules sets in To test this idea I have made a trip to Honningsvåg, in northern Norway, the expenses being borne by the Government Research Fund of 1919 Honningsvåg is a small fishing village in the vicinity of the North Cape (lat 71°, long 26° E approximately) At this place the sun is constantly below the horizon from Nov 20 to Jan 23 I stayed there from Dec 5 to Dec 11 Being primarily interested in large scale variations in the atmospheric transmission, I brought only a rather crude equipment, consisting of a small objective single prism quartz spectrograph equatorially mounted on tripod, with a 3 in guiding telescope fitted with a hand-driven gear The length of the spectrum obtained by this instrument is about 8 mm from 5000 A to 3000 A, and the dispersion at 3000 A about 100 A to a millimetre

The principal result of the trip is that Cario's conjecture has thus far not been confirmed I photographed the spectra of several early type stars having relatively much radiation in the ultra violet (α Lyræ, γ Cassiopeiæ, η Ursæ Majoris), but the spectra are cut off near 3000 A in all cases This result appears to vitiate the hope of penetrating beyond the 3000 A. barrier, at the same time as it may lend enhanced interest to the problem of atmospheric ozone The equipment was insufficient to determine the height and thickness of the ozone layer, and it may be that Cario's idea is right in so far that ozone is no longer situated at the height of 50 km found in lower latitudes In this connexion it may be remarked that Honningsvåg is situated in the auroral belt, and from the auroral spectrum we infer that in this region free oxygen atoms will be present at a height of 100 km and upwards It is natural to infer that where monatomic and diatomic oxygen exist there will also be formed ozone, and that during the arctic night the ozone layer rises to greater heights than usual It is hoped to look further into this problem on a later occasion

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Zoological Nomenclature

IN accordance with the provisions governing possible suspension of the rules, the undersigned has the honour to invite the attention of the zoological profession to the fact that application for suspension of the rules has been made in the case of *Nycteribia* Latreille, 1796, monotype *Pediculus vespertilionis* Linn, 1758 The Commission is requested to set aside the monotype designated in 1796 and to validate *Nycteribia pedicularia* 1805 as type of *Nycteribia* *Pediculus vespertilionis* Linn was based on an acarine (described and figured by Frisch, 1728) which is now classified in *Spinturnix* Latreille was dealing with an insect which he erroneously determined as *Pediculus vespertilionis* Unless the rules are suspended, *Nycteribia* should be transferred from the Diptera to the Acarina and should supplant *Spinturnix*, this would cause extreme confusion and upset generic and supergeneric nomenclature which has been accepted without challenge for about a century

A vote on the foregoing proposition will be delayed until about Jan 1, 1930, in order to give zoologists interested in the case ample opportunity to express their opinions, *pro* or *con*, to the International Commission on Zoological Nomenclature

C W STILES
(Secretary of Commission)

U S Public Health Service,
Washington, D C

Science and Life

THE attitude taken by Mr Aldous Huxley, as described by Major Church in NATURE of Jan 5, p 6, does not strike me as altogether novel Was it not given—and I think with implicit condemnation—by Matthew Arnold in four unsurpassable lines of "The New Syrens"

"Hath your wisdom felt emotions?
Will it weep our burning tears?
Hath it drunk of our love potions,
Crowning moments with the wealth of years?"

Arnold's 'wisdom' did not connote science but psychologically the parallel is close It is one of time's and heredity's ironies that Mr Huxley is grandson of one of that band of scientific friends who, with their wives, sometimes resorted to the woods and read poetry aloud, and, if memory do not play me false, the great Huxley on one such occasion read "Denone" Those great scientists' wisdoms could and did feel emotions at any rate

FRANK H PERRYCOSTE

Polperro, Cornwall Jan 13

The Green Ray

As seen from my house at St Leonards, the sun sets at sea up to about this date, and behind the South Downs from now onwards Only in the latter case have I been able occasionally to observe the greenishness of the last ray, and then indistinctly, owing no doubt to the habitual want of clearness of the atmosphere over the Downs at sunset To day the sun set behind the sloping face (as it appears from here) of Beachy Head The ray was pure green

T S DYMOND

St Leonards-on Sea,
Sussex, Jan 19

Oyster Cultivation and Related Researches in the British Isles.

By Dr J H ORTON

A VERY small proportion of the oysters sold in the British Isles is taken directly from public grounds inshore or offshore Natural offshore oyster beds become fished out soon after they are found, as a result of indiscriminate fishing, and inshore public beds suffer the same fate unless fishing is suitably restricted The difficulties in enforcing culture on public grounds have led to the leasing of the chief oyster beds in Britain to private individuals or companies or corporate bodies Thus the bulk of the oyster supply is produced by oyster cultivation of some kind

The English native oyster (*Ostrea edulis*) is in its essential characters the same as the Dutch and the flat French oyster, therefore young Dutch and young flat French oysters may be laid down on English beds to grow and wax fat, and then be only recognisable as of foreign origin by an expert Large numbers of the Portuguese oyster (*Ostrea angulata*) are now produced in France, and an increasing number is being imported into England and sold after remaining on English beds for one or more years American oysters (*Ostrea virginica*) are also imported from Canada and America, and similarly relaid and sold after remaining on English beds for one or more years Neither of these two latter species breeds naturally in any quantity in England Thus oyster production in England is concentrated chiefly on *Ostrea edulis*

In the British Isles, oyster cultivators fall into two chief groups, namely, one concerned in producing young oysters in great quantity and rearing them to an age of 2 to 4 years for sale to the other group, whose business it is to buy medium sized oysters, grow them, and place them on the market in a plump or fat condition the former are oyster producers, the latter, oyster merchants On some producing grounds suitable portions of the beds may be utilised for rearing oysters for direct sale to the public, while on well stocked fattening grounds good crops of young oysters may sometimes be obtained Other beds, which have been condemned as being liable to pollution by sewage, may still be used for oyster culture, but all oysters produced on them must be transplanted for purification[14, 17] before being offered for sale for consumption

NATURAL OYSTER CULTIVATION

The cultivation of oysters (hereafter assumed to be *O edulis*) may be considered in three natural stages (1) oyster production, (2) growth culture, (3) fattening, but during all these stages the care of the beds forms an important fourth section of the work

Oyster Production

Individual female functioning English oysters (*O edulis*) produce from a few hundred thousand to about 1¼ million eggs in a breeding season, according to the size of the individual The eggs are laid inside the shell and are retained there by the parent until they develop into freely swimming individuals (*larvæ*) which, after a short hazardous life, 10 days or more,[1] in the tidal streams, settle down on any suitable clean object and transform themselves into the sedentary young oyster, which at this stage is called an oyster *spat* The season's settlement of young oysters is thus called a *spatfall*

The primary object of the oyster producer is to secure a large spatfall To attain this object the oyster cultivator must know the main facts regarding breeding and the best conditions for the settlement of the larvæ, and must keep a reasonably large stock[2] of large spawning oysters to ensure a spatfall in only moderately good seasons The beginning of the breeding season in *O edulis* varies locally and with season according to the weather conditions from about the middle of May to the beginning of July On English beds it has

FIG 1—Photograph of a 'blacksick' oyster The semi lunar shaped black area in the upper right part of the shell is composed of hundreds of thousands of shelled larvæ Individual larvæ may be distinguishable with a lens in the original on the lower middle part of the shell (× *ca.* ¾)

been found that breeding begins in a fair proportion, 10 to 20 per cent[3] of the population, soon after a temperature of 60° F or above is maintained in the bulk of the seawater In practice the oyster cultivator examines[4] samples of oysters at about the usual time breeding begins in a particular locality until a small proportion of blacksick[5] oysters are found A *blacksick* oyster is one containing larvæ which appear black in mass, in which condition they are ready to begin a free existence (Fig 1)

As soon as a small percentage[6] of blacksick oysters are found, a previously prepared quantity of clean shell is gradually spread day by day over those portions of the beds known to have secured spatfalls in other seasons Any kind of clean material, but especially shell, whether of cockles, oysters, mussels, limpets, or clean shell gravel, and collectively called cultch, may be used Twenty tons of this material is easily absorbed on even small beds The English method of catching spat by merely throwing clean shell into the sea is very

simple and primitive in comparison with continental and other foreign methods,[7] but is defensible on the high cost of labour in this country and the (im)probability of adequate economic return on outlay on extra labour costs

After the distribution of the cultch, the oyster cultivator, like the farmer on land, is—except for nursing the beds—largely at the mercy of the weather After a long fine summer a good fall of spat may be expected on most well stocked beds, but the spatfall may fail in some good summers, or in other rare cases be so prolific as to bespatter almost every available object, including some fucoid seaweeds In cold summers a good spatfall is not expected These facts prove that certain special conditions, which do not always occur in the sea, are requisite for the proper development of the larvæ and/or the transformation which occurs when the active larva settles down to become the sedentary mollusc In a good season, upwards to 30 spat on an oyster shell may be found about the middle of July, in a poor one, shells with 2-5 spat may be difficult to find, and, except in prolific seasons, there is probably a heavy mortality at this stage

Growth Culture

When the cultivator has obtained a good spat fall, the young oysters are left on the ground undisturbed until at least the following winter or spring, and usually until the size of one inch or more is attained At about the size of 1½ to 2 inches, the young oysters in the sea begin mostly to grow away from the cultch shell, and can then be, and are, freed therefrom with a knife, one of the operations known as *culling* Culling the young oysters from cultch is an important operation and permits the animal afterwards to grow into a good shape, that is, with a deeply concave as opposed to a flat shell After being culled, the young oysters may be returned to the original bed, or relaid on special nursery beds kept for particular size-groups, and left to grow under supervision until required for sale or relaying on fattening beds Well shaped oysters grown in the sea rarely attain to more than a length of one inch at an age of one year,[8] and afterwards on the average increase in size (length) with a decreasing yearly increment, on the other hand, flat-growing oysters may grow in length at a greater rate than one inch per year In the sea, increase in shell area occurs in the spring and again in late summer or autumn, as is especially well shown on the Fal Estuary Beds In the apparent dormant period in summer there is some reason to believe[8] that the shell may be increasing in thickness Well-shaped oysters usually grow slowly in size, and rarely attain marketable size before having spent five summers in the sea

Fattening

The natural fattening of oysters consists simply in relaying stock on whole beds or parts of beds where previous experience has shown that fattening will usually occur The oysters fatten themselves naturally, but in the sea there are also good and bad years for fattening, although certain beds rarely fail Fattening depends ultimately upon the occurrence of an abundant supply of microscopic vegetable food, especially diatoms and peridinians[9, 10] In the sea the amount of this food available shows fluctuations,[9, 11] with usually maximal growths in spring and late summer or autumn, and the natural fattening of oysters at the approach of winter is believed to be dependent upon the later maximum[9] In France, oysters are artificially fattened in ponds or *claires* by feeding them with a superabundance of diatoms If, therefore, by artificial means a superabundance of microscopic vegetable organisms could be produced cheaply in restricted estuarine localities in the sea, the fattening of the contained oysters, if these were otherwise healthy, would be assured

In spring and summer the food absorbed is utilised largely in the formation of reproductive products When an oyster is ready to spawn it is usually in fine fat condition, but in this condition the fatness is due to the great development of eggs or sperm, whereas the fatness attained on the approach of winter is quite different[9] and due to an accumulation of food reserves[12]

Care of the Beds

During all the preceding phases of oyster culture a constant watch on the beds is maintained for the purpose of collecting and destroying pests and enemies, such as, on one hand, slipper limpets, mussels, ascidians, and on some grounds the larger seaweeds, and on the other hand, the oyster borers, *Murex*, *Purpura*, and *Urosalpinx*, and starfishes Muddy beds may need to be harrowed, and sandy beds inspected after a succession of gales, or after gales of unusual severity, while constant supervision may be required to prevent or detect poaching

Artificial Oyster Production

The well known fact that one individual *O edulis* at an age of about six years may incubate one million or more young to an advanced stage of development has presented an alluring prospect of easily acquired wealth to experimental cultivators for more than half a century Many attempts have been made in the past in specially constructed oyster ponds and tanks to obtain young oysters from the millions of larvæ which can easily be obtained in such ponds or tanks, but with economic failure Large spatfalls have been obtained in some years, followed by complete failure in many others Such experiments in the past, however, have been based on empirical procedure, and there is no reason to suppose that success will not ultimately be attained as the factors concerned in promoting (1) the healthy life of the larvæ, (2) an easy transformation of the larva to spat, and (3) an assured early development of the spat become known The experience gained in rearing the larvæ of sea-urchins, crabs, ascidians, limpets, worms, and even crabs at the Plymouth laboratory,[13] all tends to show that the undertaking is more difficult than would be anticipated The difficulty is also

generally greater when there is—as in the case of the oyster—a metamorphic stage in the development at which stage there is generally a very great mortality Academic researches on rearing marine animals have however been made only on a small scale and additional difficulties arise when it is necessary to carry out experiments in a large volume of unchanged—but changing—water

In recent years the Government Fisheries Department has attacked the problem of the artificial production of oysters in the mussel purification tanks at Conway with variable but probably greater success than has attended previous efforts The Government experiments were begun on empirical lines in the post War period but are now being continued on a scientific plan[14] which is taking into account all the factors likely to affect a successful issue such as nature of the larval food constituents of the water enemies as well as temperature conditions ultimate success in obtaining falls of millions of spat is probably only a question of time The recent recognition of the importance of the minor chemical constituents[15] of sea water especially in a stationary body of water has widened the scope of these experiments but at the same time narrows down the possible unknown factors The problem is thus expanding beyond the province of the biologist and whether the original staff is big enough—even with hearty outside co operation—to press the investigation with vigour may be reasonably doubted

The original idea of these experiments was to discover whether oysters could be produced in bulk in tanks on a commercial scale Oysters have been produced in large quantities but the commercial aspect has not yet been sufficiently considered Millions of oysters may be procured in tanks but unless a reasonable proportion are eventually put on the market at a profit the project is commercially unsound It is desirable therefore that a large scale commercial experiment should be carried out side by side with investigations into the exact conditions for ensuring a large spatfall

ARTIFICIAL FATTENING

The success of continental cultivators in fattening oysters artificially leaves no doubt that the same process—if commercially desirable—could be carried out in England by supplying a superabundance of diatoms in tanks or ponds Such oysters are however usually green gilled and are not favoured by the English consumer so that the problem in artificial fattening in England would comprise also the production of a white fish

Recent researches[10] however indicate that a superabundance of diatoms and/or peridinians might be obtained in closed estuarine waters by artificially maintaining the slight concentration of essential foodstuffs phosphates and nitrates necessary for heavy crops of this planktonic vegetation Supplied with abundant food of this nature oysters would fatten naturally and with a minimum of outlay on labour

RESEARCH PROBLEMS

The main research problems in connexion with oyster culture are those concerned with increasing the stock of young individuals and with fattening oysters for the market While the artificial production of young oysters may eventually be an assured commercial proposition it is possible that slight improvements in the methods of securing oyster spat on the natural oyster beds may rival even successful artificial methods in the ultimate return on outlay Experiments on the treatment of shell cultch before distribution in the sea and novel methods of catching spat in the sea are reasonable problems for research

The liaison between the oyster cultivator and the Fisheries Department is rendered difficult by the private or semi private nature of most oyster fisheries but mutual benefit would undoubtedly follow if a young Government oyster biologist were assigned the special duty of studying and conducting continuous researches on oyster culture and its problems in all parts of Great Britain The biologist would be able to help the practical man in everything relating to biology such as sex spawning development spatfall feeding exposure dangers etc and in return would learn a great deal about the bionomics of the oyster in its relation to culture[16] the local problems in oyster culture and would eventually become a beneficent expert

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Vitamin D and the Structure of Human Teeth

IN a recent review in NATURE (Vol 121 p 325 1928) on the influence of diet upon the teeth reference was made to the work of M Mellanby and her collaborators on the effect of diet on the structure of the teeth and on the incidence of caries More recently the same author has brought forward evidence indicating a definite relationship between structure and the incidence of caries and has also shown that it is possible to arrest the spread of this condition by suitable alterations in the diet (M Mellanby *Brit Dental Jour* Dec 15, 1927 M Mellanby and C L Pattison *Brit Med Jour* vol ii p 1079 1928)

An analysis of the results obtained from the

microscopic examination of sections of deciduous teeth showed that only 372 out of 1036 sectioned were normal or nearly normal in structure 27 per cent of these had carious cavities, on the other hand, of the 664 which showed definite defects of structure, or hypoplasia, no less than 85 per cent were carious The relationship held with each individual type of tooth thus the incisors, which are usually the best calcified, showed the lowest incidence of caries, whilst the second molars, which are the worst calcified, were the most susceptible A similar relationship between structure and caries was observed in the examination of 266 permanent teeth About 10 per cent of each of the different type of teeth appeared to be exceptions to this relationship, a well calcified tooth showing caries or vice versa Apart from the fact that some of these exceptions may be more apparent than real, since the classification of a tooth depends on the structure of the part not affected by caries, and this may be well calcified, the disease having commenced in the badly calcified portion, there is a further factor to be taken into account, the possible change in the resistance of the tooth after eruption Analysis of the structure of the secondary dentine formed in response to disease or injury showed that, in two thirds of these exceptions, the presence or absence of caries could be correlated with a poorly formed or a well calcified secondary dentine respectively This latter observation has a further importance in that it indicates that the resistance of the teeth can be changed after eruption by variations in the degree of calcification of the newly-formed dentine one factor, and probably the most important, is the diet

In previous investigations, Mellanby and Pattison have shown that diets favourable to calcification limited the initiation and spread of caries in children and frequently caused a hardening of teeth in which caries had started In these experiments the diets were improved by giving milk, eggs, and cod liver oil, thus supplying both vitamins A and D, or were made less satisfactory by increasing the oatmeal content or cutting down the vitamin intake The present work was undertaken to see whether the good effect of cod liver oil, for example, was due to its vitamin A or vitamin D content it appears to show that vitamin D has a marked influence in preventing the spread of caries in children and in promoting its arrest, whilst vitamin A probably has no, or only a slight, effect

The work described deals with the influence of vitamin D, supplied in the form of irradiated ergosterol (1 to 4 c c radiostol solution daily) A group of 21 children was placed on a complete average diet, supplemented by the addition of the irradiated ergosterol the test lasted twenty eight weeks and the amount and extent and degree of hardness or softness of each carious area were noted in each child at the beginning and end of the experiment The average age of the children was less than six years The results obtained were somewhat better than in the previous tests and showed that the addition of the vitamin D had a pronounced effect in preventing the initiation of new carious foci, limiting the spread of the disease, and apparently arresting its progress in many cases Owing to the younger age of the children of this group, however, somewhat better results might be expected, since there is presumably less interference with the pulp tissue of the teeth by the natural processes of root absorption which occur at a later age

When only the results obtained with children less than six years of age in the previous tests were compared with those of the present experiment, it was found that the radiostol supplement was only slightly more effective than the addition of cod liver oil, extra eggs, and milk to the diet Thus the average number of teeth per child showing initiation or increase of caries was 1 0 and 1 4 respectively in these two groups, on the diet containing little fat soluble vitamins and additional oatmeal the figure was 5 0 teeth per child, whilst on a diet containing no oatmeal and only a moderate quantity of fat soluble vitamins it was 3 3 The average amount of hardening or arrest of caries per child was, in the four groups, 3 9, 3 7, 0 2, and 1 2 respectively Put in another way, the 21 children had 185 carious teeth at the beginning of the investigation 4 new points appeared during the experiment, 2 in one child 16 areas showed some spread of the disease, 4 being found again in one child, who was apparently given too little of the irradiated ergosterol In the majority of the teeth the soft and active caries was in course of arrest, or had actually been arrested, so far as could be ascertained Microscopic examination of some of these teeth indicated that the process of healing was accompanied by the laying down of well calcified secondary dentine

If these results can be confirmed in adults, they will be of great importance owing to the widespread prevalence of caries among civilised populations to-day In a recent review on the subject of the influence of diet upon the teeth, M Mellanby discusses the question whether the incidence of caries can be explained by the nature of the diets consumed, and concludes that such may indeed be the case (*Physiol Reviews*, vol 8, p 545, 1928) The two factors which favour the development of caries are the consumption of large quantities of cereals and the small intake of the foodstuffs which contain vitamin D, milk, butter, cheese, and eggs If an inadequate intake of this vitamin is only a partial cause of the prevalence of caries, this deficiency must be very widespread amongst all grades of society in civilised nations to day

It will be of great interest to see if the spread of caries can be prevented by the administration of irradiated ergosterol in some form to adults if, as seems probable, this will be the case, then a simple method of preventing dental decay will be available and will be a great stimulus to an increased consumption of milk and milk products, with further benefits to health and well being, or, for those who prefer it, the diet can be supplemented by a synthetic vitamin D preparation

Obituary

SIR W T THISELTON-DYER, K C M G

WILLIAM TURNER THISELTON DYER, son of Dr W G Thiselton Dyer, was born in Westminster on July 28, 1843 At King's College School, where his contemporaries included Prof Saintsbury and the late Dr Henry Trimen, Dyer was first mathematical scholar as school boys Trimen and he were companions on botanical excursions near London Matriculating in the University of London, Dyer entered King's College, meaning, like Trimen, to study medicine in Dyer's case the intention only went far enough to qualify him for eventual admission to the Society of Apothecaries as a 'member by apprenticeship' At King's College his contemporaries included Sir Charles Lyall, whose participation in Dyer's botanical pursuits made them companions in a vacation walking tour, and provided Lyall in after life with relaxation from the tasks of an Indian official and the studies of an Oriental scholar This friendship, and the fact that relatives of his father were resident in Madras, while his maternal uncle, T A C Firminger, author of the classic "Manual of Gardening in India," was a chaplain in Bengal, may have induced the idea of an Indian career under which Dyer, at twenty, went up to Christ Church, Oxford, as a Junior Student whose mathematical aptitude and classical proficiency had left unimpaired his early botanical interests

At Oxford, where Dyer took his degree in mathematics, any thoughts of an Indian career disappeared He came under the influence of Profs Rolleston and Daubeny, and formed intimate friendships with his contemporary Prof H N Moseley and their junior, Sir Ray Lankester, who migrated from Cambridge to Christ Church in 1866 His friend Trimen, who had graduated as M B London in 1865, at once adopted a botanical career, and in 1866, Dyer collaborated with him in the preparation of their "Flora of Middlesex," which was published in 1869 In 1867, Dyer obtained a first class in the Oxford final Natural History School, and in 1868 became professor of natural history in the Royal Agricultural College, Cirencester Here he found in Dr A H Church, professor of chemistry, a colleague on whom the influence of Daubeny had also been marked Impressed by the Yale text book, "How Crops Grow," Dyer assisted Church to prepare an authorised edition of Prof S H Johnson's work, adapted to English conditions, which appeared in 1869 In 1870, Dyer graduated as B Sc London, and was appointed professor of botany in the Royal College of Science, Ireland Early in 1872 he was again in London on Jan 17 he was appointed professor of botany to the Royal Horticultural Society, and assumed office on Feb 13 Two days later he was elected a fellow of the Linnean Society

While working for the Horticultural Society at Chiswick and South Kensington, Dyer gave assistance to the director of Kew, the delegates of the Clarendon Press, and the professor of biology in the Royal College of Science His work at Chiswick included plant identification This entailed contact with Kew, and brought him an invitation to assist in preparing the "Flora of British India," the first part of which appeared in May 1872 By 1873, Dyer had described the Indian species of six natural families of flowering plants his contribution, which includes an emendation of the "Genera Plantarum" of Bentham and Hooker, was issued in January 1874 The Clarendon Press had undertaken to publish an English edition of a 'Text-book of Botany' by Prof Sachs Mr A W Bennett was employed to translate, Dyer was engaged to edit this work, which was published in 1874 The transfer of the School of Mines from Jermyn Street to South Kensington enabled Prof Huxley to initiate his laboratory course of biological instruction Dyer became one of Huxley's demonstrators, and was left to organise and conduct the botanical part of the course, which began on June 24, 1873, and was much appreciated in May 1874 he was elected to the Council of the Linnean Society

When Dr J D Hooker became director of Kew in 1865, the assistant directorship he had held during 1855–65 was suppressed In 1875 the assistant directorship was revived Hooker was asked to select an incumbent That year Dyer began his share of Huxley's course on Mar 6 on June 16 he informed the Horticultural Society that he had been appointed assistant director of Kew, and resigned their service Dyer's duties under Hooker at Kew did not deprive Huxley of his help at South Kensington, in 1876, Dyer's South Kensington course opened on June 24, in 1880 it began on July 7

Hooker assigned to Dyer, as assistant director, the conduct of the colonial activities of Kew almost the first of his tasks was to have historic consequences It was thanks to Dyer that in the autumn of 1875, Peradeniya received the young *Hevea* plants, the progeny of which now stocks the rubber plantations of Ceylon and Malaya It was Dyer who in 1880 sent his friend Trimen, then director of the Peradeniya garden, the selected varieties of Cacao from Trinidad still grown in Ceylon When, in 1877, Dyer became Hooker's son in law, he was given charge of a laboratory for original investigation by workers of any nationality, erected at Kew by a private donor in 1876 under Dyer's management it became, in American judgment, "the best botanical laboratory in Europe" When, in 1882, another private benefaction gave Kew a rock garden, its design and construction were entrusted to Dyer In 1880, Dyer's work for Huxley at South Kensington secured his election to the Royal Society his work for the Colonial Office was recognised by his being created C M G in 1882 In 1884 he was again elected to the Council of the Linnean Society, in 1885, when Hooker retired, Dyer was appointed director of Kew

As director Dyer at first experienced many calls on his time He served as vice president of the Linnean Society, 1885–87, on the Council of the Royal Society, 1886–88, as vice-president of the

Horticultural Society, 1887–89, as a fellow of the University of London 1887–90 He now resolved to avoid such distractions from official duty carrying his resolution so far as to decline nomination as president of the British Association the only exception to his self imposed rule of 1890 was his service as vice president of the Royal Society in 1896–97 This rule could not apply to official commands he had served as a Royal Commissioner for the Melbourne Centennial Exhibition in 1888 he served in the same capacity for the Paris International Exhibition in 1900 and for the St Louis Exhibition in 1904 Nor did he decline service on committees appointed by the Royal and other societies to deal with specific matters of public importance Perhaps his most valuable work of this kind was that connected with the Chelsea Physic Garden As a member of the Corporation to which since 1673 the Chelsea Garden belonged and as director of the younger sister institution that public apathy in 1837 had placed in equal jeopardy Dyer took the initiative in the movement which in 1899 saved the Chelsea Garden from impending destruction

The intercourse between Kew and India of 1778–1815 was renewed when Kew became a national institution in 1841 Though India Office councillors and secretaries were but rarely botanists like Dyer s friend Lyall they were usually acquainted with India and its peoples and could appreciate the bearing of the work at Kew on economic questions with which they were familiar This intercourse Dyer maintained in 1892 he was created a C I E As assistant director Dyer had induced a similar appreciation of Kew at the Colonial Office where personal knowledge of our many tropical possessions was necessarily less general As director Dyer was now consulted as regards policy The advice he gave was simple and effective From 1887 onwards colonial administrators copied the course followed by the East India Company from 1778 onwards Botanic stations were set up under competent curators in direct correspondence with Kew to assist these stations Dyer in 1887 founded the *Kew Bulletin* The success of this policy was explained to the House of Commons by the Colonial Secretary on Aug 2 1898 in 1899 Dyer was created K C M G The satisfaction felt by overseas correspondents of Kew was shared by Christ Church Dyer was elected an honorary Senior Student But a sacrifice was exacted The assistant director of Kew Dr D Morris became Imperial Commissioner West Indian Agricultural Department history repeated itself the assistant directorship again fell into abeyance

Though it has been remarked that Dyer s success was largely due to his intense feeling for the living plant he realised that without a herbarium a botanic garden is like a rudderless ship he described the Dipterocarps of India for Hooker the year he organised the botanical portion of Huxley s course Dyer saw the Kew herbarium extended in 1877 and had to double it himself in 1902 As director he inherited the botanical survey of our overseas possessions undertaken by the elder Hooker at the request of Government A flora of South Africa begun in 1859 was suspended in 1865 one of Australia begun in 1863 was completed in 1878 A flora of tropical Africa begun in 1868 was suspended in 1877 that of British India begun in 1872 was still in progress in 1885 Dyer devoted the herbarium resources to furthering the Indian flora only with the end in sight did Dyer resume the flora of South Africa in 1896 only when the Indian work was completed in 1897 did he resume the flora of tropical Africa Dyer s competence as a descriptive botanist made him a perfect editor abstaining from personal contribution to the text of either flora he was able to edit both

Dyer obtained relief when he persuaded his friend Dr D H Scott to assume honorary keepership of the Jodrell laboratory which enabled him to reorganise the museum collections to improve the lecture course for young gardeners and to convert into a corps the groups of uniformed attendants at Kew on whose efficiency and courtesy the safety of the collections and the comfort of visitors depend With the interests of this corps he associated himself he made it a personal charge and wore the uniform of its inspector

Dyer s intense feeling for the living plant was shown in 1887 when he provided an Alpine house as an annex to the rock garden was apparent in the energy with which he replaced outworn conservatories and modernised plant houses structurally sound and was especially manifest in his work on the outdoor collections What Dyer accomplished is best appreciated by those who realise that Kew owes to Sir William Hooker director 1841–65 its salient features such as the lake and the great vistas that it owes to Sir Joseph Hooker director 1865 85 the condition and arrangement of the collections of hardy trees and shrubs as well as the avenues in the arboretum and the paths in the pleasure grounds that make the collections accessible Dyer brought to bear on what his predecessors had provided the care and skill of an artist able to produce landscape effects that should be suave and ample Again his method was simple and his success striking Without any sacrifice of scientific interest he gave access to the glades and laid open the informal vistas that induce at Kew a sense of space and bring into view objects that attract attention

In 1899 the winter garden left unfinished since 1862 was completed a Secretary of State indebted to Kew for scientific assistance had secured in 1894 the review of a decision with which for a generation the public department in charge of the gardens had concurred That department admirably qualified to administer Kew as a place of public resort now strove to control the official correspondence of Kew as a scientific centre The difficulty as regards the department chiefly concerned was overcome when Dyer in 1902 was appointed botanical adviser to the Secretary of State for the Colonies To obviate its recurrence Kew was transferred in 1903 for administrative purposes to a new department sympathetic with the scientific activities of Kew, but without

experience as regards places of public resort in 1905, Dyer retired from Kew, but retained his Colonial Office appointment until 1906

At Witcombe, in Gloucestershire, where Dyer now settled, he took for a decade an active part in the business of the county, for which he became a justice of the peace In 1908 he was appointed the representative for the University of Oxford on the County Education Committee, and in 1909 became a member of the Court of the University of Bristol On behalf of Kew he continued to edit the "Flora of Tropical Africa" until 1913, and the 'Flora Capensis' until it was completed Meanwhile at Oxford it had not been forgotten that Dyer was a scholar as well as a biologist, to whom, in both capacities, Daubeny had imparted his own keen interest in the identity of classical plants Dyer undertook to assist those engaged in revising the lexicon of Liddell and Scott In 1916, Dyer reviewed his obligations much as he had done in 1890, and, as a result, resigned a position in the Royal Horticultural Society, to which he had been appointed when Hooker died in 1911, relinquished the seat on the County Education Committee which he had occupied since 1908, left the Athenæum, to which he was elected 'by the Committee' in 1885, and retired from the Royal Society His work for the editors of the new Liddell and Scott had involved much careful investigation from 1916 until his death on Dec 23, 1928, Dyer's time, when health permitted, was largely spent in continuing his classical studies, and amassing material for a glossary of ancient plant names

Transparent honesty of purpose and rigid accuracy of statement were, in the case of Dyer, associated with clear vision, firm decision, and prompt action Direct in speech and incisive in style, his intention could never be mistaken To these qualities, which made him a wise adviser and a faithful friend, were added a mine of knowledge and a width of culture that made social intercourse with him an intellectual feast With these qualities, that were attractive, were associated two habits that, though only defects of his merits, at times interfered with his influence as a man of affairs His instinctive dislike of ambiguity, which included aversion to any attempt at compromise of principle, induced a habit of which he was conscious that endeared him to correspondents abroad, but was disconcerting to colleagues in Great Britain The other habit, of which he was evidently unconscious, caused him to wound the susceptibilities of many of those whose views he found himself unable to accept To this latter habit may be attributed Dyer's failure to find support for proposals that, when afterwards submitted by others, were accepted without debate In his choice of men Dyer paid more regard to character, of which he was only a tolerable judge, than to capacity, in the assessment of which he was singularly successful

The type of botanical teaching of which Dyer was the pioneer in Britain has induced an academic impression against which Dyer's administrative activities were an eloquent though silent protest to that impression we owe the modification of his colonial policy Dyer's work for Kew will survive long after his precise share therein has been forgotten Should it prove possible to make available the fruits of the labours of his later years, it may be that in these will be found an even greater claim to grateful remembrance As it is, Dyer has placed mankind under two important obligations His manhood was given to teaching science that the improvement of natural knowledge for use is a service as honourable as the improvement of natural knowledge for discovery he used the leisure of his later years in reminding letters that the interest of science in the 'humanities' may be as great as that of scholarship Both are lessons still badly needed

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The story of Thiselton Dyer's life as related above by another contributor is only half told if his wide knowledge of ancient botany and of classical literature be not recorded and appraised, for besides being an eminent botanist and a first-class man of affairs, he was a scholar of wide reading and meticulous accuracy

Sooner or later men come back to what they loved as boys, and Dyer told me once that Martyn's "Georgicks" had been his favourite school book John Martyn, F R S, was professor of botany in Cambridge in the middle of the eighteenth century, his two books, one an edition of the "Georgicks," the other of the "Bucolicks," were school books for a hundred years, and it is a pity that they are used no more The very pictures in Martyn were delightful the olive tree and the 'hyacinth,' the *cerinthæ ignobile gramen* beloved of bees, the *flos in pratis cui nomen amello*, the figure and description of Virgil's plough, and the picture of the northern heavens with the Dragon winding like a river between the Great and Little Bears—one remembers them all In the botanical chapter which Dyer wrote for Sir John Sandys' "Companion to Latin Studies," while nothing of moment is left out, yet Virgil always has the middle of the stage, and Martyn's two books head the long list of quoted authorities Dyer was always fond of old books, and liked (as he said) to "take stock of the harvest of accurate and acute observation to be found in the writings of authors now almost fallen into oblivion, yet long recognised as classical" He bought a Clarke's Odyssey for half a crown when he was a schoolboy, in a small book shop, "a mere open booth, in the purlieus of Leicester Square", and he used it to the last, because it "gave the comments of Eustathius, which no modern editor will look at"

Thiselton Dyer took his degree at Oxford in mathematics, a fact which I have not seen mentioned, he was proud of it, and prouder still that he had been a pupil of Henry Smith's "Is it not recorded" (he says in one of his letters to me) "in the preface to the Cambridge edition of his works? *That* I think earned me more respect from L . r than he would have bestowed on what Augustine Birrell called a 'mere botanist'"

Thiselton Dyer's classical papers are few in number and represent imperfectly his vast stores

of knowledge His unrivalled knowledge of Greek plant names he gave freely to the new edition of Liddell and Scott, regretting all the while that much useful and appropriate matter, the great mass of his accumulated notes, could find no place therein He knew, as many another scholar knows, that what we wanted was no mere Lexicon but a "Thesaurus," and that England should have been rich and generous enough to let her scholars make one But Liddell and Scott held the field and "queered the pitch," he said, and though he loved the great book, all the more because it hailed from his own College, he spoke of it as "So and so's dry as dust pemmican,—if you can conceive the similitude"

Apart from his contributions to the Lexicon and his two chapters in the Companions to Latin and Greek Studies, Thiselton Dyer's chief writings on classical botany are found in the *Journal of Philology*, now dead, which flourished under the editorship of Ingram Bywater and Henry Jackson Dyer wrote at least three papers for that journal, these three including articles on about thirty "Ancient Plant names," all more or less obscure and difficult One of the smaller articles (by way of example) was on the ἐλαίαγνος, a plant mentioned by Theophrastus, which the old Liddell and Scott called "a Bœotian marsh plant, perhaps *myrica* or *sweet gale*" Dyer had no difficulty in showing that it was not *myrica*, which means tamarisk, nor was it sweet gale, which is a northern plant unknown in Greece He showed in the end that the word were better written ἑλέαγνος, which is plain Greek for a marsh lambkin, and that Theophrastus's plant was nothing but the common goat willow, *Salix caprea*, whose catkins country folk still call "lambs' tails" For a more elaborate essay take the one on *Amomum*, a very difficult word, which Thiselton Dyer traced up and down through an immense field of old literature He begins by showing, from Theophrastus, how both Amomum and Cardamomum came from India, and how when Pliny and Dioscorides call them natives of Media, Pontus, and Armenia, these are but the trade routes by which they came Pliny's Cardamomum is easily disposed of, it is the common Malabar Cardamom of the apothecaries Amomum is much more difficult, but Dyer shows how Pliny's description of it as a shrub (*frutex*), growing on the mountains (*montuosus*), with its spiny inflorescence on a short stalk (*palmi altitudine*), with its scaly leaves or bracts "like those of a Pomegranate," which soon turn dry and brittle (*posterius fragile*), and need to be gently handled and kept together (*manipulatim leniter componi*),—how all this tallies word for word with the Nepaul Cardamom (*A subulatum*) of the Himalayan slopes, still used in India as a cheap substitute for the real thing He then discovers the very same identification in the rare "Commentatio de Amomo" of Nicolo Maragna, a Veronese physician, whom Caspar Bauhin quotes in his "Pinax" Lastly, he proceeds to discuss, carefully and patiently, the uncertain source and difficult etymology of the word

No busy and laborious man ever finishes his life's work, no good man reaps all the harvest he has sown But it is earnestly to be hoped that what Thiselton Dyer has left behind, ungarnered and unpublished, may see the light of day Just eight years ago he wrote me 'I have projected a Glossary [of classical Plant names], and the Clarendon Press profess to be willing to print it I have the whole thing in slips, and I go on annotating But whether with impaired health I shall be able to accomplish a fair copy for the printer is a problem" A sympathetic and friendly biographer said the other day that Thiselton Dyer would be "remembered as a great botanical administrator" Even such qualities as he possessed and such services as he rendered in this capacity will, I think, prove less memorable than the scholar s task which was the pastime of his busy life and the occupation of his later years D W T

Dr S J Mauchly

Sebastian Jacob Mauchly, physicist with the Department of Terrestrial Magnetism of the Carnegie Institution of Washington since 1914, died on Dec 24, at his home in Chevy Chase, Maryland, after a long illness Dr Mauchly, who was fifty years of age, specialised in terrestrial electricity, and as chief of the Section of Terrestrial Electricity of the Department was responsible for the development and improvement of many instruments for observing the electric elements at field and observatory stations He made numerous valuable contributions to this branch of science and was the first to direct attention to the apparent universal twenty four hour term in the diurnal variation of the earth s electric field This fundamental result was deduced by him largely from his discussions of the work at sea by the *Carnegie*, and he later corroborated this conclusion by extensive investigations of results at land stations over the entire globe He was also chief of the solar eclipse expedition of the Carnegie Institution of Washington to Lakin, Kansas, in 1918, and co author of Vol 5 of Researches of the Department of Terrestrial Magnetism, 1926

Dr Mauchly received his educational training at the University of Cincinnati, where in the Department of Physics he took the degree of A B in 1911, and as Hanna research fellow, that of Ph D in 1913 He was a fellow of the American Physical Society and the American Association for the Advancement of Science, and a member of the American Geophysical Union, International Geophysical Union, Washington Academy of Sciences (serving on the board of editors of the *Journal*, 1925–26), and of the Washington Philosophical Society (recording secretary 1919–21)

We regret to announce the following deaths

Mr Bernard Coventry, C I E, first director and principal of the Agricultural Research Institute and College, Pusa, Behar, on Jan. 26, aged sixty nine years

Prof Johannes von Kries, of Freiburg im Breisgau, the distinguished physiologist and editor of the third German edition of Helmholtz's 'Physiological Optics," on Dec 30, aged seventy five years

News and Views.

SIR ALFRED EWING'S intimation that he desires to retire from the principalship of the University of Edinburgh on Sept 30 came as a great surprise to his colleagues He refers in his letter to the University Court to the fact that in a few weeks he will be seventy four years of age, but his friends have noted no sign of failing in his wide scientific outlook or in his grasp of the business of the University Since 1916, when Sir Alfred was offered and accepted the principalship in succession to the late Sir William Turner, the University has expanded greatly—thirteen new chairs have been founded Especially noteworthy is the acquisition of a site of 115 acres on the southern edge of the city, on which now stand the departments of chemistry and geology, and on which the new departments of zoology and animal breeding are in course of erection Other extensions include the purchase of premises near the Old College for English and modern languages, the reconstruction of the Department of Surgery and the building of a laboratory for clinical medicine at the Royal Infirmary Early in his tenure of office Sir Alfred successfully carried through the negotiations which resulted in the admission of women to full privileges as students in the Faculty of Medicine, and later he brought into closer co operation with the University the Training College for Teachers and the Edinburgh and East of Scotland College of Agriculture, the heads of which are professors in the University Sir Alfred has shown himself throughout to be a man of great energy and resource He has never spared himself when he could serve the University, and he has done much to bring about a better understanding between the University and the city It was entirely fitting, therefore, that at a meeting of the Lord Provost's Committee, held on the day on which Sir Alfred's resignation was announced, it was unanimously resolved to recommend that the freedom of the city be conferred upon him

THE paper read by Mr G Fletcher at the Royal Society of Arts on Wednesday, Jan 30, on the Shannon hydro electric scheme, attracted a very large audience It will be remembered that four years ago the Irish Free State decided to undertake an ambitious scheme for supplying hydro electric power to Ireland The scheme was devised by an eminent firm of German electrical engineers, and after being slightly modified by a committee of four continental experts, who spent a few weeks making a local study of the problem, was adopted, the whole undertaking being at the expense of the Government Provision was made not only for the existing needs of a large part of the country, but also for the needs of industries which it is hoped will be established when power is available Next October the first stage of the scheme is to be completed, the expense up to this stage being about five million pounds

THERE are about 130 towns and villages in the area of supply of the Shannon hydro electric scheme which have not an electric supply It is proposed to charge consumers on the basis of 2*d* per unit and an additional charge varying from 6*d* to half a crown per week, depending on their Poor law valuation For small houses the wiring will be done on the hire purchase system, a fixed weekly charge being made until the cost has been refunded Public institutions and factories will be charged 6d per unit for lighting As Dublin has a very active and efficient municipal supply by steam generating plant, it is difficult to see how it can benefit from the Shannon scheme The annual cost of the interest and the power losses in the 'grid' to Dublin from the Shannon power house will be very appreciable Whilst it is easy to criticise the scheme from the business point of view, the new power station when finished will be a valuable asset Every effort must be made to attract industries requiring electric power to Ireland The danger lies in political pressure leading to a rapid expansion of the grid unjustified by the demand and to the scrapping of profitable steam undertakings

A NUMBER of papers dealing with band spectra have appeared recently in the *Proceedings of the Royal Society* Following on the investigations of Lord Rayleigh on mercury, and of Prof W E Curtis and Dr Jevons on helium, and of Sir Robert Robertson on ammonia, phosphine, and arsine, to mention only a few of the more important that were published last year, there is now a group of six communications by various authors in the first number of the *Proceedings* for 1929 One of these, by Dr Kapuscinski and Miss Eymers, on intensity measurements in the secondary spectrum of hydrogen, is purely descriptive, although it constitutes a valuable appendix to the wave length tables of this spectrum which were recently issued from Bonn, and provides rich material for its further analysis The other papers all deal with problems of molecular structure, and include independent contributions by Dr R C Johnson and Dr Jevons on the spectra of certain fluorides, a paper by F A Jenkins and H A de Lazlo on the celebrated bands of silicon nitride, and one by J M Walter and S Barratt on the band spectra associated with the vapours of zinc, cadmium, and mercury

THE main interest of band spectra appears now to have shifted to the problems which have been raised by the new mechanics, and to the elucidation of the nature of the electronic transitions involved in the production of bands in the visible and ultra violet regions In cases where a definite decision is possible, the new quantum theory, here as elsewhere, predicts results which are in better agreement with experiment than those which would follow from the older quantum theory , in the matter of electronic energy levels, there can also be little doubt that the theories which are being developed by Dr Hund in Germany and by Prof Mulliken in America, to which several references have been made in NATURE, are essentially correct, although there still remains a great deal to be done in this connexion It is unfortunate that very many

substances which give rise to well-developed band-spectra cannot be isolated as chemical individuals, there seems to be no immediate prospect of obtaining molecular helium outside of a discharge tube, for example, and even the fluorides which were mentioned above are probably chemically unstable or unimportant compounds Hydrogen and carbon monoxide are two notable exceptions *inter alia*, and in such cases identity of the molecular constants deduced from the band spectra and from physico chemical data respectively provides a valuable test of the theoretical interpretations of both sets of measurements

CABLE advices from the *Carnegie* after her arrival at Callao on Jan 14 state that on Jan 8 a new submarine ridge, which has been named Merriam Ridge, was discovered At the point of crossing, Merriam Ridge is ten miles wide and rises 3000 metres above the 4000 metre depth on either side The top of the ridge, in lat 24° 57′ S, long 82° 15′ W, is at 1168 metres, this value being checked by three sounding methods, namely, sonic, wire, and thermometer, to within 20 metres When 60 miles west of Callao, the surface temperature, which had been 21 5° C, dropped to 19° C and remained at that value until arrival at Callao Captain Ault's report shows that the activities in the various observational programmes are being successfully continued, the work between Easter Island and Callao (Dec 12, 1928–Jan 14, 1929) including 38 declination stations, 15 horizontal intensity and inclination stations, 17 oceanographic stations, 72 sonic depth stations, 12 pilot balloon flights, 25 complete photographic 24 hour potential gradient records, 4 24 hour series of other atmospheric-electric observations, 20 biological stations, 6 evaporation series The vessel was expected to leave Callao about Feb 3 en route to Papeete, Tahiti, Society Islands, where she is due to arrive early in March

PRIOR to the War, all the medical schools of the University of London (with the exception of the London School of Medicine for Women) were restricted to men, but it will be remembered that during the War seven of the schools admitted women in addition These facilities for women were withdrawn a short time ago, except in the case of University College Hospital, which still admits a limited quota The action of the authorities of the medical schools aroused considerable discussion, and a Committee was appointed by the Senate of the University of London "to consider the question of the Limitations placed upon the Medical Education of Women Undergraduates" According to the report which has just been issued, it is considered that the facilities in London for *pre clinical* instruction of women are ample, and it is only the withdrawal of those for *clinical* instruction which has given rise to the present inquiry The Committee thinks that there is no valid argument against the provision of co education, but that co education to be successful must be voluntary No countenance is therefore given to the suggestion which has been made that the University should enforce a policy of co education upon the medical (and other) schools by withdrawal of recognition or other means Such a policy, to be logical, would have to be applied all round, and this would force men upon women's colleges, and men upon the London School of Medicine for Women! Nor does it seem desirable that co education should be universal in the medical schools of London, for such a policy might result that in some schools there would be only a very small number of women—possibly only one woman—which on various grounds is highly undesirable The Committee recommends, therefore, and the Senate has given general approval, that its report be communicated to the schools in the Faculty of Medicine, and that the vice chancellor be requested to invite them to consider the possibility of admitting a quota of women students in the future

THE Joint Expedition of the Percy Sladen Memorial Fund and the American School of Prehistoric Research, which has recently been investigating caves in the Sulaimani district of north east Iraq, has discovered Palæolithic remains in two of the sites in which soundings were made A small cave near Zarzi, about 30 miles north-west of Sulaimani, which was excavated completely, yielded an abundant late Upper Palæolithic industry which has marked affinities with the Upper Aurignacian of Central Europe and of the Grotte des Enfants at Mentone The presence of Tardenoisian microliths in the upper part of the deposit shows that this industry, although typologically Aurignacian, represents the final development of the Upper Palæolithic in a region into which the Magdalenian never penetrated The second Palæolithic site discovered was near Hazar Merd, 10 miles due west of Sulaimani A large cave known locally as the 'Dark Cave' (*Ashkot i Tarik*) contained Mousterian hearths three metres in thickness, underlying a mixed layer with pottery of various ages The Mousterian industry is true to type, and contains no elements that are not already well known in the Mousterian of Europe It is marked by an abundance of well made points and a relative scarcity of side scrapers Owing to its size the 'Dark Cave' could only be partially excavated, but it is hoped that the American School of Prehistoric Research will be able to complete the work next season These are the first recorded Palæolithic finds in southern Kurdistan, but there is no doubt that the whole area is rich in promise, and the comparatively settled state of the country should now make it possible to carry on work in this region, which for many years has been practically closed to Europeans

THE executive committee of the Cambridge Preservation Society, which was formed in March of last year, has published a short statement of a particular part of its work during the past year It was felt that at all costs the pleasant road to Madingley, the view from Madingley Hill and the approach to Coton village by the footpath should be secured Finding that the risk was acute, it was decided to use whatever funds were available to this end Assisted by Col ffennell of Whytham, near Oxford, Prof Trevelyan, and other benefactors, the Society was enabled to purchase for £22,300 about 380 acres of land, including the south side of Madingley Hill The danger to a most beloved part of the countryside west of Cambridge has thus

been averted for the time, but by the acquisition of this land the Society has incurred a considerable debt The generous benefactors who have lent money must be repaid, and it is certain that further help will be required The Society intends, however, to postpone to a later date any public appeal for funds in order not to interfere with the efforts of the University to raise money for meeting the conditions of the recent benefaction from the International Education Board

Among the many scientific investigations being made into food storage and preservation are those relating to the handling and carriage of fruits to Great Britain from various parts of the Empire, and every fruiterer s shop in London is evidence of the value of those investigations Few people, however, realise the extent of our fresh fruit trade with Australia and South Africa, the latter of which exports annually 27,000 tons of soft fruits such as grapes pears, and peaches, and 45,000 tons of citrus fruit, principally oranges A few years back, such fruits were placed directly in the refrigerated holds of ships and much waste occurred To day, all the fruit is pre cooled before shipment, and *Engineering* for Jan 25 contains a description of the buildings and methods used at Cape Town for this purpose Fruit on arrival by train is run into a large insulated air lock, unloaded on to standard size trolleys and then electrically hoisted and traversed into cooling chambers, of which there are 72, each capable of holding 12 trolleys Soft summer fruits such as grapes and peaches are then cooled from 90° to 34° F, while winter fruits have to be cooled from a temperature of about 60° to 40° F In shipping, the trolleys are run out and hoisted directly aboard Many problems of construction, refrigeration, and insulation were involved in the design of the building and machinery, the consulting engineer for which was Mr E A Griffiths, physicist to the South African Government

Sir William Bragg delivered the first of a course of three lectures at the Royal Institution on "The Early History of X Rays" on Jan 31 Sir William stated that no scientific discovery before or since that of Röntgen in 1895 has excited such immediate or universal interest The effect was all the greater because scientific workers everywhere were able to repeat the experiment without difficulty From a scientific point of view the new departure was equally remarkable As Maxwell pointed out long ago, the problem of the relation between electricity and matter was more likely to receive explanation from the study of the electric spark than in any other way, but the key had not been found in 1895 Röntgen's discovery so increased the facilities for experiment, and was so suggestive of the directions in which to move, that the world was soon led to the recognition of the electron as the all important factor Before 1895 the wealth of experimental results lacked co ordination The work of Faraday had shown that molecules in a liquid were broken into parts of which some carrying negative electricity moved towards the negative and others towards the positive pole But the puzzle was as to why it was so easy to send the current through the liquid and so difficult to send it through a gas Yet in certain circumstances, such as heating by a flame or the action of ultra violet light, a gas could be made to conduct quite well It became clear that the molecules of the gas must be broken before the electricity could pass, just as in a liquid The knowledge of the fact that the atom was not the unchangeable entity which it had been assumed to be, and that an electron could be torn from it and become free to move and shatter other atoms, was still hidden from the experimenter, and it was this which caused all his results to lack cohesion But he could at once appreciate the new discovery and move on towards the explanations that were forthcoming almost immediately

At a meeting of the Newcomen Society on Jan 23, Mr Rhys Jenkin read a paper entitled "A Chapter in the History of the Water Supply of London," in which he dealt mainly with the pumping apparatus erected by Sir Edward Ford on the banks of the Thames a little to the east of Somerset House Ford, who was born in 1605 and died in 1670, was a royalist soldier of good family and married the sister of Ireton, son in law of Cromwell During the Commonwealth he turned his attention to practical invention, and in 1655 was granted a patent for a pumping apparatus The patent is not merely of interest in the history of mechanics, but also it was one of only about a dozen such patents granted by Cromwell, and it is the only one the enrolment of which is to be found at the Public Record Office The machinery, which was horse worked, was in a tower and, according to the description contained in the *Journal des Voyages de Monsieur de Conconys*, published in 1666, it consisted of four suction pumps in series worked by levers and rods moved by a cam wheel turned by the horses The tower is shown in a contemporary plan of the district by Hollar Ford's pumping engine was one of several which were erected on the Thames between Chelsea and Wapping in the seventeenth century

Particulars of America's longest railway tunnel were recently given in a *Daily Science News Bulletin* published by Science Service, Washington, D C The tunnel is on the Great Northern Railway, and pierces the Cascade Range of mountains about a hundred miles east of Seattle Up to now, the longest railway tunnel in America was the Moffatt tunnel in Colorado, 6 11 miles long The Cascade tunnel is 8 miles long, and is said to be exceeded in length by only the St Gothard, Simplon, Loetschberg, and Mt Cenis tunnels through the Alps Another very long tunnel, however, is the Apennine Tunnel on the Apulian Aqueduct in southern Italy This is about 9½ miles long In constructing the Cascade tunnel, advantage was taken of the existence of a deep valley over the projected line, and from this a shaft more than 600 feet deep was sunk From this shaft auxiliary tunnels were bored east and west, and these again were used to give access to several working faces in the main tunnel By this means, progress was so rapid that the work was carried through in three years The tunnel was open for traffic on Jan 12, trains being worked through by powerful electric locomotives supplied with current at 11,000 volts

ACCORDING to the Report of the Building Research Board for the year 1927 (London H M Stationery Office, 3s net), which has recently appeared, the staff of the Board at the end of the year was 111, and committees on weathering, on structures and on acoustics, assist the Board The work in progress deals with weathering, building materials, cements, plasters, asphalts, with wind pressure and vibrations, and with heating, ventilation, and acoustics of buildings The sulphuric acid from coal fires appears to be greatly responsible for weathering, and capillary effects for the decay of sandstone in the vicinity of limestone Thermal stresses due to unequal temperature or to freezing cause spalling Washing a surface at intervals and plastic repairs with oxychloride cement retard decay The tests of structures show that their strength cannot be predicted from that of the bricks of which they are composed Although results of such importance as these are being obtained and are made public by reports and by articles in the technical and the daily Press, the Board feels that full advantage is not being taken of the information by the industry Closer co operation between the Board and the industry is much to be desired

THE nature of the work done by research associations does not as a rule lead to immediate and sensational achievements It does, however, often lead to considerable improvements in manufacture and consequent reductions of price To take a concrete case, the British Electrical and Allied Industries Research Association, which has just issued its eighth annual report, points out that its researches on cables have led to very appreciable economies being effected in the distribution of electrical energy The consumer gets part of this saving as the price of supply is reduced Similarly, the researches on the properties of steam which Prof H L Callendar carried out for the Association will probably result in improvements in the manufacture of steam turbines, and again the public will get part of the benefit The Association spent last year £25,000, of which the Government contributed £7200 This grant will rapidly diminish as the end of the second five years of the existence of the Association approaches, and it is necessary to take immediate action At present the manufacturing section of the industry provides the larger part of the cost and eighty per cent of the personnel of the numerous technical committees It has been pointed out that if every consumer of electrical energy contributed one farthing for each pound paid for electrical energy consumed, then the sum provided would pay for the whole annual cost of the researches of the Association, and the consumer would doubtless reap the benefit We are afraid, however, the procedure underlying this suggestion could not be generalised and applied to researches in other directions It would, therefore, even if it were equitable, be impossible to put directly into practice

Two recent communications, one to the Manchester Literary and Philosophical Society, by Mr H Garnett, and another to the International Photographic Conference, have directed attention to the work of John Benjamin Dancer, one of that numerous class of scientific worthies whose names remain almost unknown, while their work is the property of all Who, for example, knows that Dancer was the inventor of the porous earthen pot used in millions of 'wet' batteries? Who remembers that he devised the spring contact breaker or current interrupter originally applied to the induction coil, and still employed in almost the same form in every electric bell throughout the world? He was also the inventor of the minute photographs on glass which attracted attention at one time, he was one of the earliest workers on the form of photography introduced by Daguerre, and he experimented on the electro deposition of copper Another of his inventions was the binocular stereoscopic camera, the original example of which is preserved at Manchester and was described to the International Photographic Conference last summer Like his father and grandfather, an optician by calling, Dancer made all the apparatus used by Joule in his classical experiments on the mechanical theory of heat Born in London in 1812, he died in straitened circumstances in Manchester on Nov 22, 1887, having for many years been blind

THE Royal Cornwall Polytechnic Society was founded in 1833 at the suggestion of Miss Anna Maria Fox, its first purpose being to encourage a number of clever workmen who spent their spare time in constructing models and devising inventions It set itself to provide technical education, and to encourage industry and ingenuity in a community distinguished for its mechanical skill, as well as to finance any invention likely to benefit local industries, particularly mining The short history of the Society, which is included in the annual report for 1927, shows how the meetings became a recognised centre for the exhibition and demonstration of new inventions, some of which have become of world wide renown and usefulness, such as Were Fox's dipping needle deflector, Nobel's nitro glycerine, and Loam's man engine Even more generally important have been the Society's educational efforts Evening classes in mining subjects, a science school at Falmouth, and classes in connexion with South Kensington examinations, all owe their origin to its foresight and energy The reports of 1927 and 1928 (vol 6, pts 1 and 2) show that the arts and crafts are still being encouraged by extensive prize schemes in connexion with the annual exhibition and special school work In addition to their formal records, the reports also contain notes on eminent Cornishmen, and original articles on "Ancient Mining in Cornwall," French war prisoners in Cornwall, and the "China Clay Industry," as well as an address by Lord Gainford on "The Progress of Broadcasting"

Two articles of special biological interest in the December *Scientific Monthly* are Prof Chas G Rogers' "Physiological Evidences of Evolution and Animal Relationship," and Prof Theodore Korpányi's "Transplantation of Organs" In the former is discussed the possible evolutionary significance of the osmotic pressure of body fluids, their composition, and the relationship between their hydrogen ion concentration and that of sea water, blood coagulation

and blood reactions, chemical actions and regulations in living bodies, excretion, reproduction, and death. The discussion suggests many physiological lines along which further investigation might well lead to biological conclusions of general importance. Prof. Korpányi's article describes the wonderful success which attended his efforts to transplant organs, such as amphibian and mammal eyes, the testis and spleen of amphibians, the spleen of rats, from their original connexions to entirely novel positions. Even amongst mammalia he has found that in its own proper situation a transplanted eye may regenerate the optic nerve and regain a power of vision.

THE Ossolinski Institute at Leopol (Lwow), in Polish Galicia, has recently celebrated its centenary. The founder died in 1826, his library arrived at Leopol in 1827. The Institute has been an irreducible bastion of Polish culture and intellectual life during a tragic century. The union of Polish learned societies in Leopol now presents a *Bulletin* (in French) describing their activities during 1925 and 1926. There are some thirty associated societies grouped in unions round the six Polish universities. Intellectual life is just emerging from war time depressions. Books in Polish are a difficulty exaggerated by high costs of printing, import taxes on paper, lack of modern printing machinery, and the discouragement of publishers who find only a restricted market. The suggestion is made that publishers might agree not to publish competitive scientific books with similar contents, also to prepare a programme of educational text books. Co-operation with foreign countries is welcomed; scientific publications have been sent to Tokyo and received from America, but on the whole it has proved easier to exchange periodicals than personal visits. Visitors to Poland will find the 94 pages of this *Bulletin* a useful vade-mecum as a guide to persons and institutions.

THE Registrar General has issued the provisional figures of the birth and death rates and infantile mortality during 1928 for England and Wales. The birth and death rates are respectively 16·7 and 11·7 per 1000 population, and the infantile mortality is 65 deaths under one year per 1000 live births. The birth rate is 0·1 per 1000 above that of 1927, and the death rate is 0·6 per 1000 below that of 1927, and only 0·1 per 1000 above the lowest recorded (1923 and 1926). The infantile mortality rate is the lowest on record, 4 per 1000 births below that of 1923.

DR. J. A. V. BUTLER, lecturer in physical chemistry in the University of Edinburgh, has been awarded the Meldola Medal of the Institute of Chemistry for his published work on the modern theory of conducting solutions. The Meldola Medal is awarded annually to the chemist whose published chemical work shows the most promise, and is brought to the notice of the administrators during the year ending Dec. 31, prior to the award. The recipient must be a British subject of not more than thirty years of age at the time of the completion of the work.

IT is announced in *Science* that Dr. Oliver Kamm, head of the department of chemical research of Parke, Davis and Company, formerly professor of organic chemistry in the University of Illinois, has been awarded the prize of 1000 dollars of the American Association for the Advancement of Science. The prize is awarded each year for a notable contribution to science presented at the annual meeting of the association and the associated scientific societies. Dr. Kamm's paper, presented before the section of chemistry at the recent New York meeting of the Association, was entitled "Hormones from the Pituitary Glands".

ACCORDING to the *Times* of Jan. 31, Signor Mussolini has presented to Switzerland a part of the scientific manuscripts of Albrecht von Haller, which were deposited at the Brera Library in Milan, and in the University of Pavia. Haller has sometimes been called the father of modern physiology. Born at Berne on Oct. 16, 1708, as a boy he acquired knowledge with ease, and as a man displayed immense industry and unusual versatility. His medical studies were prosecuted at Tubingen and at Leyden, where he came under the influence of Boerhaave. He practised for a time in his native town, and from 1736 until 1753 was professor of anatomy and botany at Göttingen. Returning to Berne, he there compiled his "Elementa Physiologiæ" and other works, took part in public affairs, and corresponded with eminent men in all parts of the world. He died at Berne on Dec. 12, 1777.

AT the recent annual meeting of the Botanical Society of America, held in New York City, the following were elected as Corresponding Members: Prof. C. H. M. Flahault, professor of botany in the University of Montpellier; Dr. D. H. Scott, lately honorary keeper of the Jodrell Laboratory, Royal Botanic Gardens, Kew; John I. Briquet, director of the Botanic Gardens, Geneva; and Alexander Zahlbruckner, director of the botanical section of the Natural History Museum, Vienna. The following were elected officers for the Society: *President*, Dr. Margaret C. Ferguson, Wellesley College; *Vice President*, Dr. L. W. Sharp, Cornell University.

IN our issue of Aug. 18, 1928, p. 251, reference was made to a 'record' low barometric pressure of 665·1 mm. (886·8 millibars) during a typhoon. It should have been stated that the observation was made on Aug. 18, 1927.

THE *Leicester Museum, Art Gallery, and Library Bulletin*, a quarterly leaflet of about eight pages, is a useful means of keeping touch between the public and the institutions. The January number contains a select list of recent additions to the Library, but none of them, out of about a hundred serious volumes on science, art, and philosophy, deals with biological science. The special exhibition illustrating "Sport in the Midlands," from contemporary paintings, drawings, and prints of the last two centuries, proved to be a great success.

THE Ministry of Health has issued to sanitary authorities a *Circular* (No 955) directing attention to the rapid spread of influenza reported from the United States and Canada, and bringing to the notice of local authorities the Memorandum on Influenza issued in 1927 (Memo 2/Med) This memorandum reviews the 1918–19 epidemic, discusses the bacteriology of the disease and mode of infection, and describes measures of personal protection and precautions when attacked, and outlines the action to be taken by sanitary authorities to combat influenza outbreaks According to a recent *Daily Science News Bulletin*, issued by Science Service of Washington D C, more than a million cases of influenza occurred in the United States before Christmas, but the epidemic is now subsiding

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —A county librarian under the Leicestershire County Council—The Director of Education County Education Office, Leicester (Feb 16) A live stock officer under the Ministry of Agriculture and Fisheries—The Secretary, Ministry of Agriculture and Fisheries 10 Whitehall Place S W 1 (Feb 18) An assistant chemist under the Northern Coke Research Committee—Prof Briscoe, Armstrong College, Newcastle upon Tyne (Feb 18) A tutor for philosophy, politics, and economics at St Hilda s College, Oxford—The Secretary, St Hilda s College Oxford (Feb 23) A lecturer in pharmaceutics at the Chelsea School of Pharmacy—The Principal Chelsea School of Pharmacy, Chelsea Polytechnic, S W 3 (Feb 25) A biologist, and a chemist, with experience of physiological problems to assist in carrying out a survey of the Estuary of the River Tees—The Director Marine Biological Laboratory Plymouth (Feb 28) A junior scientific officer under the Directorate of Scientific Research of the Air Ministry, primarily for research work in the aerodynamics department of the Royal Aircraft Establishment—The Chief Superintendent R A F, South Farnborough Hants (Mar 2, quoting A 319) A head of the engineering department of the Technical Institute, Gillingham—R L Wills Elm House 15 New Road Avenue Chatham (Mar 9) An associate professorship of geography in the University of Sydney—The Agent General for New South Wales Australia House, Strand W C 2 (Mar 16) A professor of philosophy in the University of Lucknow—The Registrar The University Lucknow India (Mar 17) A professor of medicine in the University of Lucknow The Registrar The University Lucknow India (Mar 31) An assistant lecturer and demonstrator at the Leathersellers Technical College—The Acting Principal Leathersellers Technical College, 176 Tower Bridge Road S E 1 Assistant directorships of a social survey—The Professor of Social Science, University, Liverpool An entomologist for original research work into the bionomics of Tacchardia Lacca —"India," care of Richardson and Co 26 King Street, St James s, S W 1

Our Astronomical Column

A CHART OF MERCURY —M E M Antoniadi published a chart of Mercury in *Comptes rendus* of the Paris Academy of Sciences in the autumn of 1927 This is reproduced with a few additions resulting from his 1928 observations, with the 33 inch Meudon refractor in the *B A A Journal* for January 1929 Some of the markings, in particular those in the north east quadrant, closely resemble those in Schiaparelli s chart, reproduced in *Ast Nach*, 2944, but the south west quadrant is practically filled with a dusky shading, the darker regions of this coincide with narrow dark markings drawn by Schiaparelli

M Antoniadi looks on the 88 day rotation, first announced by Schiaparelli, as completely established He remarks that it has long been known that Japetus always turns one face to Saturn, this being proved by its notable variation of light in different regions of its orbit, and as its distance from Saturn is 62 Saturn radii, it was only to be expected that the sun, the density of which is twice that of Saturn, should produce a like effect on Mercury at a distance of 82 sun radii He considers that the axis of rotation of Mercury is not exactly perpendicular to the orbit plane, but does not indicate the amount or the direction of the deviation

EPHEMERIDES OF VARIABLE STARS —At the meeting of the International Astronomical Union at Rome in 1922, the Cracow Observatory was entrusted with the calculation and publication of ephemerides of variable stars This task has been energetically fulfilled by Prof T Banachiewicz, and the seventh annual volume has just appeared The descriptive matter is given in two languages, Polish and Peano's simplified Latin The latter is easily read by any one with an elementary knowledge of Latin or the derived languages

There is a useful index to the ephemerides and notes on certain stars Use is made of three different time systems, the Greenwich civil day (U T), the Julian day, and the new system proposed by the author, which begins at Greenwich midnight on Jan 0 1801 Tables are given to reduce from any of these systems to the others The volume contains other useful tables, of precession, obliquity of ecliptic, moon s equation, etc

THE BRIGHTNESS OF THE NEBULÆ *Ast Nach*, 5609, contains a paper by A Markov of Pulkovo on the brightness of the spiral nebulæ He has used both his own observations and those of many other observers, in particular Dr Wirtz of Strasbourg He concludes that the brightness of the spirals is far too high to be explained by reflection from the galaxy, as was suggested by Prof Lindemann He finds the surface brightness of the Andromeda nebula to be abnormally high, twelve times that of the average spiral and seventy six times that deduced for the galaxy, the latter, according to its surface brightness, though not according to its size, is to be ranked among the faint spirals The star density in the Andromeda nebula is concluded to be unusually great, and confirmation of this is drawn from the large number of novæ that have appeared in it Its central brightness (measured from a square 1″ in the side) is given as 17 mag, falling to 21 mag at a distance of 5′ along the minor axis The Pulkovo results give the value + 0 68 mag for the average colour index of the spirals

The paper also deals with gaseous nebulæ, the photographic brightness of some of them was found to be lower than the visual brightness Their brightness as a whole is stated to be of the same order as that of the gas in an exhausted tube under the influence of soft cathode rays

Research Items

MARRIAGE IN AFRICA —In *Man* for January, Mr E Torday examines critically the terms in use in relation to the consideration which passes between the contracting parties among African peoples at the time of marriage It is now almost universally admitted that marriage does not consist of a purchase Among the Amazulu, for example, the bride remains a member of her clan, and the contract may be sealed by a mere trifle, such as a hoe or basket of corn as well as by many head of cattle Among the Natal Kaffirs the amount was fixed by disinterested parties The natives themselves repudiate the idea of a sale, and on the Congo the Boloki regarded the gifts of food and sugar cane wine as proof that the woman was not 'sold as a slave,' but 'given as a free woman' As a matter of fact it is among those peoples where the bride price is not given that marriage is most irrevocable 'Bride price' is therefore absurd, and 'dower' and 'settlement' are not more appropriate, as these terms should be reserved for customs which really belong to these classes, such as the hoes which a girl received from her father among the Chaga at circumcision and takes with her on her marriage, and the settlements of cattle made by the Bamangwato father to serve his daughter during her marriage and in case of widowhood The use of specific native terms is to be deprecated, as notwithstanding their obvious accuracy they lead to confusion and the exact implication is not clear to the ordinary individual The sealing of the contract is the act of paramount importance It takes place between groups and not individuals, and each group pledges itself to see to the carrying out of the contract Hence if the wife fail, the group supplies her place by offering a sister or other equivalent and thus recognises its obligation to continue the performance of the contract Further, the consideration, whatever it may be, may be divided among the members of the bride's clan or group Tentatively, 'earnest' is suggested for discussion, as implying the undertaking to ensure the due observance of the contract

HARAPPA IN THE VEDAS —The early culture discovered at Harappa in the Punjab and Mohenjo Daro in the Indus Valley up to the present has been regarded as of non Vedic type, and it has been stated that there is no indication that the builders of these cities were akin to the Rig Vedic Aryas Sir John Marshall thinks the most reasonable view is that they were the pre Aryan (probably Dravidian) people known in the Vedas as the Dasyus or Asuras, whose culture was destroyed in the second or third millenium B C by the invading Aryans In the *Indian Antiquary* for January, Binode Behari Ray Vedaratna puts forward a claim that these relics belong to the Aryan civilisation In ancient times, when the Aryans inhabited the Sapta Sindhu region and the Punjab, perhaps they erected two cities on the god made land —the alluvial land on the bed of the Sindhu Samudra There was in Vedic times a city named Hariyupia, where a battle was fought between King Abhyavarti and Varashikha's sons in which, Indra fighting on the side of the former, the latter were defeated and slain Another battle was fought between Kavi, brother of Abhyavarti and the Aryan invader Sudas in which, again through the aid of Indra, Kavi was defeated and slain This battle was fought near the river Paruṣṇi (Ravi) If the city Hariyupia was on the bank of the river, it may be Harappa which is on the eastern side of the Râvi Abhyavarti and Kavi appear, therefore, as kings of Harappa who fought against the invader Sudas was contemporary with King Trasadasyu, who reigned in the fifth millenium Abhyavarti was an emperor from whom Bharadvaja Rishi received offerings of cows and other things It may therefore be concluded that he was an Arya of the Prithu dynasty, who lived in the fifth millenium, and that at that period Harappa was the capital of an Arya emperor and was not non Aryan

'FUNNEL MOUTHED' TADPOLES —The function of the 'funnel' mouth of certain *Megalophrys* tadpoles has been for some time a subject for investigation Dr Sunder Lal Hora, in his latest communication ("Further Observations on the Oral Apparatus of the Tadpoles of the genus *Megalophrys*" *Records of the Indian Museum*, vol 30, pt 1, 1928), describes the results of his most recent researches into the habits of these interesting larvæ The tadpoles of *Megalophrys parva* are abundant in shallow, swiftly running streams, and are to be found in the sheltered parts of these where they have not to contend against the torrential currents which are liable to carry them away In such situations they do not hang from the surface film and feed as they may do in quiet waters, the oral apparatus enabling them to feed at any level, even at the bottom, and the funnel when folded helping by excluding large, and probably facilitating the entry of small, particles in flowing waters Whilst this oral apparatus helps to make the anterior end buoyant, the developing lungs distended with bubbles of air apparently act as hydrostatic organs and enable the animal to suspend itself at any particular level, making the whole body buoyant—a distinct advantage when it is carried away by a flood Living thus in hill streams which are liable to break up into a series of pools and puddles, dry up altogether, or become rapid torrents generated by a single shower, the tadpoles, according to Dr Hora, have adapted themselves to such variable conditions and evolved the funnel mouth and hydrostatic lungs

SELECTIVE FACTORS IN SALMON MIGRATION —In spite of the attention given in recent years to the influences which determine a salmon's selection of a particular river for spawning purposes, the subject is still very obscure It is clear enough that the responses to some sort of stimulus are very specific, for not only do salmon in Great Britain often return to that very river from which they set out, but also in Canada it has been found that distinct races of salmon occur in definite tributaries in the same river system, so that even selection of tributaries must be made Dr R E Foerster's observations on the migration of sockeye salmon in the Cultus Lake area of the Fraser River bear on the relations of temperature, hydrogen ion concentration, and oxygen to the up stream movement (*Canadian Field Naturalist*, January 1929) He found that while one race of sockeye salmon may, at the junction of two streams, select the colder, another may prefer the warmer, and that the same race may at one point ascend the colder and at another the warmer of the alternatives Temperature, therefore, cannot be a prominent directing influence As a rule the migrating salmon preferred a water with somewhat lower hydrogen ion concentration, and yet they avoided the waters of Sumas Creek, always lower in this factor than Sumas River Indeed, the conclusion seems to be that neither temperature, hydrogen ion concentration, nor oxygen content can be regarded as simple factors by which selection is determined, although it is reasonable to suppose that some physico chemical attribute or attributes of the waters traversed, either singly or in association, direct the route of migration

INDIAN DEEP-SEA SPONGES —In his "Report on Some Deep Sea Sponges from the Indian Museum collected by the R I M S *Investigator*, Part 2, Tetraxonida (concluded) and Euceratosa" (*Records of the Indian Museum*, vol 30, pt 1, 1928), Mr Burton continues his study of deep sea sponges These are of great interest Two specimens of *Biemna annexa* (Schmidt) were found, hitherto only recorded from the North Atlantic The diagnosis of *Sceptrospongia coronata* is based on a partial description by Dendy given in relation to his study of the origin and growth of sponge spicules These spicules are highly elaborate, as was shown by Dendy, who directed attention to their variable character, and the figures given in the present paper show the many different forms present in the one sponge The genus *Bubaris* is revised, the author removing five species to other genera and retaining thirteen, including three new species These deep sea sponges form a remarkable and valuable collection The paper is well illustrated by text figures and two photographic plates

AUSTRALASIAN MOLE CRICKETS — In the *Records of the South Australian Museum*, vol 4, No 1 (1928), Mr Norman B Tindall reviews the Australasian species of Gryllotalpidæ, which have been much neglected by recent workers He defines these insects as crickets of subterranean and aquatic habits, with the anterior legs adapted for burrowing and the ovipositor obsolete in the females All the members are water loving, frequenting light soils and sandy ground where there is ready access to moisture but it would seem that the term aquatic is not strictly applicable It is generally assumed that only male mole crickets are capable of sound production, but an examination of any of tho females of the Australian species of *Gryllotalpa* will show an apparatus on the under side of the elytra, with which individuals are capable of making themselves heard Several species are of economic importance on account of their underground burrowings, which injure certain root crops, besides helping to crumble the banks of water channels and dykes A matter of considerable interest is the recent importation of the Surinam toad (*Bufo agua*) from Porto Rico into Barbados for the purpose of destroying the mole cricket *Scapteriscus vicinus* Mr Tindall's paper is admirably illustrated and forms a useful contribution to Australian entomology

SIBERIAN METEOROLOGY —The Vladivostok Observatory, now designated the Geophysical Observatory of the Far East, has resumed publication of the meteorological observations from eastern Siberia Two parts of the *Annales de l'Observatoire central* give respectively the figures for 1916 and 1917, thus continuing the series that have already appeared The Director announces that it is hoped to publish succeeding years' work shortly and then to resume annual publication The records come from about a hundred stations in the Amur and coast regions, Kamchatka, Sakhalin, and so far north as Anadir Monthly means are given for temperature, vapour tension, humidity, cloud and wind for the seventh, thirteenth, and twenty first of the months Pressure, maximum and minimum temperatures, precipitation, and other data are also given Although there are gaps in some of the stations records, the observations are remarkably full and detailed The text is in Russian but headings are given also in French

ENVIRONMENTAL FACTORS OF PHILIPPINE BEACHES —Mr Raymond Kienholz, in his paper "Environmental Factors of Philippine Beaches, with Particular Reference to the Beach at Puerto Galera, Mindoro" (*Philippine Journal of Science*, June 1928), records various climatic observations with regard to temperature and rainfall, and relative humidity, evaporation, wind, sunshine, and soil on a sandy beach, rocky headland, and mangrove swamp The author in a former communication (*Proc Am Phil Soc*, **65**, No 5 Supplement, 1926) has discussed the effect of these factors upon the vegetation, especially with regard to the leaf The climate of the Philippines is essentially tropical The temperature is very uniform, with only slight seasonal and daily fluctuations, and the rainfall is extremely variable, but there being no dry season at Puerto Galera enables many plants to grow on the beaches all the year round, which are limited to the wetter months in other parts of the islands The relative humidity is usually high The amount of evaporation measured by means of standardised Livingston atmometers is highest at the rocky headland, lowest underneath the mangroves The rate of evaporation is closely correlated with the amount of wind, and the high evaporation rate in spite of the fairly high humidity is probably the reason for certain structural adaptations of the leaf for conserving its water supply

GEOLOGY OF BRITISH HONDURAS —Between 1921 and 1926, Mr Leslie H Ower was actively engaged in a geological investigation of the only British possession on the mainland of Central America As the territory has hitherto been very little known, a sketch of the geology from Mr Ower in the *Jour Geol*, pp 494 509, 1928, is particularly welcome British Honduras consists of a central peneplain of folded Upper Carboniferous marine beds, with granite intrusions, surrounded by unfolded limestone of about Oligocene age Deposits of ages between these two periods are unfortunately unknown The main movements can be referred to Permo carboniferous and Miocene diastrophism The trends of the Palæozoic rocks conform to those of Honduras and Guatemala, all following a series of generally east west folds that arose out of the Honduranian geosyncline Granite intrusions follow the crests of the folds Much more youthful north east to south west features are common, these being parallel to the trends of western Cuba The east coast is determined by large faults which descend rapidly into 2000 fathom water It is noteworthy that British Honduras suffered no folding during the building of the Central American mountain system This began in the Miocene, and is apparently still active British Honduras, however is outside the severe earthquake zone of the present day

MINE VENTILATION —The Engineering Experiment Station of the University of Illinois is continuing its experiments upon mine ventilation, and has just issued in *Bulletin* 184 the third part of a paper upon the measurement of air quantities and energy losses in mine entries by Messrs A C Callen and C M Smith This *Bulletin* refers wholly to measurements of air (and the calculations based thereupon) carried out at one of the mines of the Peabody Coal Company The investigation has been done with great care, and a number of interesting results have been obtained and recorded, but it is very doubtful whether these can be of any general application, seeing that they depend entirely upon the special conditions obtaining at this particular mine and do not allow of any general deductions from them

THE ISOTOPES OF NEON —In a paper which appeared in the *Philosophical Magazine* in 1920, Dr F W Aston mentioned that neon appeared to possess a third isotope, of atomic mass 21, in addition to its two well established components of masses 20 and

22, but he made no reference to this in his Bakerian lecture in 1927 T R Hogness and H W Kvalnes, who have been using the same gas to calibrate another form of mass spectrograph, now report that a peak corresponding to a singly charged ion of mass 21 invariably appears on their curves, and since they find no trace of a peak for an ion of mass 23 which could be attributed to a hydride of Ne^{22}, this cannot be due to a hydride of Ne^{20}, and is therefore ascribed by them to the third isotope of neon Their measurements, which have been published in the December number of the *Physical Review*, show that Ne^{21} atoms are rare, constituting only about the fiftieth part of ordinary neon, and they suggest that Dr Aston did not detect them in his later work because the high resolution of his apparatus had been partly attained at the expense of its sensitivity

THE DIFFRACTION OF ELECTRONS BY MICA —A number of cathode ray diffraction photographs are published by S Kikuchi in the June issue of the *Proceedings of the Imperial Academy of Japan* They were obtained with mica in an apparatus similar to that used by Prof G P Thomson, and were primarily designed to show the electron analogue of the Laue phenomena for a crystalline plate, but actually proved to be more complicated Very thin sheets of mica were found to produce an equilateral pattern built up of lines intersecting at sixty degrees, with enhanced spots at the angular points, whilst thicker sheets gave both Laue spots, diffraction circles, and sets of bright and dark lines with a unit angular spacing of thirty degrees The author has not attempted to account for all these effects in detail, although they are evidently in general agreement with the requirements of the wave mechanics, but he points out that the circles are apparently formed as the result of diffraction of the electron waves by a linear array of atoms, and that absence of this type of interaction in the case of X rays may indicate the existence of a fundamental difference between light waves and material waves

CUTTING OILS —In a lecture on cutting and quenching oils delivered by Mr C H Hudson to the Junior Institution of Engineers on Dec 21, the functions of a cutting oil were defined as (1) to lubricate the chip over and along the lip of the cutting tool and so lengthen the latter's life, (2) to disperse as rapidly as possible the heat generated by cutting, and (3) to wash away the chips, keep the work clean and prevent clogging of the machine by the accumulation of swarf In the case of soluble oils, it is essential that there should be no free acids which if present, would cause corrosion, nor are oils made from a rosin base desirable as they tend to cause gumming of the moving parts of the machine tools on which they are used The use of a lard or lard substitute cutting oil was advocated on automatic lathes and other machine tools where long tool life and working to very close limits is essential It was emphasised that the lowest priced soluble oil is not always the most economical, as the cheaper grades will not bear the same dilution and give as good results as a higher grade oil, the latter can be diluted in the proportion of 30 to 1 and the former 20 to 1, which shews a saving of one farthing per gallon in favour of the more expensive solution For operations on some special metals and other substances special lubricants and cooling agents are used, such as paraffin for soft aluminium alloys, or turpentine, in glass boring and shaping In some works lard oil and white lead mixed to a gummy consistency is used when reaming and tapping high carbon and alloy steels In the United States compressed air is used as a cooling fluid in some operations with notable success, for example, in the milling and drilling (usually done dry) of cast iron The air absorbs the heat generated without producing the glazing effect which takes place if an oil is used In connexion with methods of distributing oils to the cutting tools, a large flow of oil at comparatively low pressure is far better than a small flow at high pressure

COOLING LARGE TRANSFORMERS —During the last few years, the size of the transformers used for converting high pressure alternating current into low-pressure alternating current has been continually increasing According to *A E G Progress* for November, several units having an individual output of 60,000 kilovolt amperes (kva) at 220,000 volts are now in course of construction In the A E G (Allgemeine Elektricitäts Gesellschaft) works, a transformer with an output of 100,000 kilowatts is used for testing purposes If we assume that the power lost at full load is only one per cent, the heat generated in the transformer itself would be equal to that developed by 500 electric fires all on at once It will be seen, therefore, that very special methods have to be adopted for cooling it Since the heat losses in a transformer increase very approximately as the cube of the linear dimensions, and the cooling surface increases only as the square of the linear dimensions, the difficulty of the cooling problem increases rapidly with the size of the transformer, provided that the cost is to remain proportional to the output For transformers immersed in oil contained in a corrugated iron tank, self cooling can be used up to outputs of about 5000 kva The cooling is sometimes accelerated by forcing draughts of air along the sides of the tank Another system frequently used is to have pipes through which water is kept circulating immersed in the upper portion of the oil The quantity of water required per hour for a 10,000 kva transformer having an efficiency of 99 per cent is nearly 2000 gallons, the temperature of the oil being maintained at about 100° F The A E G, instead of forcing the water through the pipes, now draws it through by a suction process In this case if the pipe springs a leak the only thing that happens is that the oil enters the water and not vice versa, which would ruin the insulating power and the electric strength of the oil Details of many other interesting methods are given

STRUCTURE OF ETHYLENE —The November issue of the *Indian Journal of Physics*, which is largely devoted to measurements of the physical constants of organic substances, contains a paper by V I Vaidyanathan on the magnetic properties of ethylene In spite of the simplicity and importance of this compound, no determination of its susceptibility appears to have been made since Quincke reported it to be feebly paramagnetic From its constitution it should be diamagnetic, which has now been shown to be the case, the value of the molecular susceptibility ($1\ 5 \times 10^{-5}$) being close to that calculated from Pascal's additive law ($1\ 8 \times 10^{-5}$) It is also at least a remarkable coincidence that the molecular susceptibility of ethylene is almost identical with the atomic susceptibility of sulphur The two substances have sixteen electrons to the molecule and atom respectively, and this result might be regarded as confirming the view, which is now fundamental in the quantum theory of molecules, that the properties of a molecule are intimately connected with those of an atom with the same number of electrons The author has not been able to come to any definite conclusion as to the structure of ethylene, but he has pointed out that it probably contains only four electrons which are moving in large orbits, and that on this assumption the value of the effective molecular radius deduced from the susceptibility (1 A) is in reasonable accord with that obtained from the viscosity of the gas

The Grid Transmission Scheme in Great Britain

THE Electricity Act of 1926 authorised the creation of the Central Electricity Board To this Board was entrusted the work of constructing all the transmission lines required for interconnecting the power stations selected for supplying the national requirements for electrical energy It had also to supply energy to undertakings which had no power stations In a paper which was read before the Institution of Electrical Engineers on Jan 24 Messrs Johnstone Wright and C W Marshall described what has already been done and gave an outline of the projected scheme

It has to be remembered that although British engineers knew how similar schemes had worked on the Continent and in America yet they have developed on somewhat different lines in these countries and it is no easy matter to say which is the best In Great Britain the sources of energy are not only comparatively close together but they are also close to their consumers In this case the main function of the transmission line is to allow the generating plant only to operate at its most efficient load, and at the same time to reduce to a minimum the requisite stand by plant This has been done to a limited extent by existing power stations The novelty of the grid scheme lies in the high voltage employed for this purpose and the magnitude of its operations

The system of supply adopted is three phase and the pressure of supply between any pair of wires is 132 000 volts The standard frequency of 50 is adopted To illustrate the comparative smallness of the British system a map of the British Isles is shown superimposed on the area of a single large interconnected system in the United States and is nearly covered by it With the exception of Italy the systems of supply adopted in Europe are very similar The pressures in France vary between 110 and 150 kilovolts The majority of German lines work at 110 kv but there are lines in course of construction which will work either at 220 kv or 380 kv The Spanish scheme is an interesting one as it provides for a 220 kv ring main with feeders and distributors at 110 kv High tension lines already stretch along the north of Spain from Barcelona to the north of Portugal Lines operating at 132 kv are very extensively used in America and these systems are continually being extended The length of the lines operated at this voltage in America is 3824 miles The complete British system will comprise 2600 miles of circuit the wires being suspended overhead

The wires are designed so that whatever the load the variation from the normal voltage will not exceed ±5 per cent The choice of the metal to be used for the conductors was determined largely by its mechanical properties The difficulties in getting way leaves and tower sites made it essential to use spans of the maximum permissible length The selection of steel cored aluminium conductors gives general satisfaction In the case of a flash over the steel core prevents the conductor from being burned out So long as the aluminium remains sound the steel core is protected from the atmosphere The life of the aluminium therefore determines the life of the cable Tests show that this life is at least twenty five years The standard conductor consists of a central core of 7 strands of galvanised steel wire surrounded by two layers containing 12 and 18 strands respectively of aluminium wires Every strand is 0 11 inch in diameter, and the conductivity of the conductor is equivalent to that of a copper conductor 0 175 square inch in sectional area, and its normal current carrying capacity is 219 amperes The size of the conductor being much greater than if it were of copper brush discharges do not ensue until under normal atmospheric conditions the voltage attains 184 kv At less voltages the loss due to brush discharges is negligibly small

The towers used in various countries to support the wires are of very different designs Steel reinforced concrete and even wood have been used in their construction In the choice of broad base towers made of steel for the grid, æsthetic considerations played a considerable part The choice of broad base or narrow base towers was generally determined by way leave considerations The double circuit towers are 18 ft 6 in at the base and 78 ft high

The conductors are supported by strings of insulators generally nine in number the working load on which is 4000 lb These chains are subjected to very rigorous mechanical electrical porosity and thermal tests A temperature cycle test is made on each unit by immersing it in water at 93° C for an hour and then immediately plunging it into a mixture of ice and water The voltage distribution test consists in determining the fraction of the total voltage that is borne by each individual unit of the chain

The most difficult problem the engineers had to solve was to devise an efficient protective system for the grid and for solving this not much help could be obtained either from American or Continental practice Owing to the high voltage and the consequent wide space between neighbouring lines there is not much risk of trouble from birds and branches of trees Possibly also the wide spacing diminishes the risk of trouble from atmospheric discharges The solution adopted is to depend on earthing the system by means of a high conductivity earth wire and to use arcing rings for the insulators The authors state that the earth wire serves the double purpose of acting as a definite return for fault currents and as an electrostatic screen to reduce voltages induced by lightning They are going to use no lightning arrestors at least in the first instance In their opinion the comparatively few thunderstorms which occur in Great Britain do not justify the use of these protective devices

It appears that in the grid the neutral points of the transformers etc will be directly connected with the earth It is anticipated that the excess current relay will trip the line when an atmospheric discharge takes place and so the arc will be suppressed and no serious interference with the supply will ensue According however to *A E G Progress* for December 1928 practical experience does not bear out this anticipation It is known that momentary shocks are sufficient to throw extensive networks out of step especially when working near their critical load The German engineers operate with insulated neutral and use the system of coils invented by Prof Petersen to suppress the arc This system has been in operation for ten years and on the Continent the number of networks adopting it is continually increasing The 100 kv network supplying South Germany and owned by the Rhine Westphalian Electricity Company is now adopting this system exclusively The entire new 220 kv system of this Company will be equipped with Petersen coils In our opinion the reasons advanced in favour of the Petersen coils by the engineers of the Allgemeine Elektricitats Gesellschaft should be seriously considered

The question of inductive interference between power lines and communication lines has been discussed by the International Consultative Committee, and a résumé of its results is given in the paper

We are glad that the danger from electrostatic induction is recognised Danger exists from electrostatic induction for a distance of about 400 yards on each side of the 132 kv lines The maximum allowable pressure induced in a communication line has been fixed by the I C C as 300 volts Formulæ are given by the I C C to enable the induced electromotive force to be computed They are given in terms of Bessel's functions, but as these functions are written in the form $J(x, y)$ and are apparently functions of two variables, we fail to understand what they mean It is stated with great emphasis that it has been definitely decided that, from the point of view of interference with communication circuits, the earthed neutral system is better than the insulated neutral system There is nothing new in the statement that the resistivity of the matter forming the earth's surface is a predominant feature in determining the induced voltage This was known many years ago As a matter of fact the electrical resistivity of the surface ground varies from day to day

The problems that will arise in connexion with this huge network of overhead wires have hitherto received little consideration Its capacity to earth cannot be neglected, as it is very large If it were insulated at every point, then if it sparked to earth the high pressure behind the spark would maintain a continuous arc the current in which might easily be hundreds of amperes In the Bayernwerk network in south Germany (1250 miles of overhead wires) the capacity current in the arc has been computed to be between 500 and 600 amperes It is stated, however, in *A E G Progress* that the Petersen coils suppress the arcing flame at the faulty point almost instantaneously

Standard substations of six types have been adopted The minimum spacing between conductors of different phases is nine feet All the transformers are designed for outdoor working If their capacity exceeds 30,000 kva, then owing to the difficulties of transport they are made up of three single phase units star connected They are all provided with voltage regulating equipment Transport considerations made it necessary to use extremely strong tanks, as each transformer has to be capable of being transported completely immersed in oil by rail, road, and sea

In the Scottish system the River Forth is crossed near Kincardine by a span 3050 feet in length The suspension towers are each 338 feet high and the high water clearance is 158 feet The span is anchored at each end on 60-foot towers Double chains of suspension insulator units are used Each chain consists of 11 insulators The total working stress is 20,000 lb

An excellent map is given of the projected scheme of high tension transmission lines for Great Britain The Scotch scheme, which is nearest completion, shows that Carlisle, Edinburgh, and Glasgow will all be connected by a ring main There are four large hydroelectric stations between Dundee and Inverness The concentration of large stations on the Clyde is noticeable Between Liverpool, Manchester, Leeds, and Sheffield there are many large power stations, and similarly round Birmingham and in London Cambridge will be in direct connexion with Lincoln and London Along the south coast of England the transmission lines will extend from Plymouth to Folkestone through Southampton From Southampton they will extend to Bristol, Worcester, Cardiff, and South Wales In North Wales there are several large hydroelectric generating stations, but these are not in connexion with the grid

A few tables of the constructional costs for Scotland are given For normal lines the costs of the lattice towers account for nearly half the total costs The costs of the conductors are 30 per cent, and of the insulators 11 per cent of the total The costs of the large high tension transformers used average about 14 shillings per kilovolt ampere at 10,000 kva size to about 5 shillings per kva at 60,000 kva size The price of a small substation equipment averaged about £20,000 For larger substations the cost was about twice as much

Structure of the Stars

ON Friday, Feb 1, Prof A S Eddington delivered the fifteenth Thomas Hawksley lecture before the Institution of Mechanical Engineers, on "Engineering Principles in the Machinery of the Stars" In introducing a general account of his well known theory of the internal constitution of the stars, Prof Eddington remarked that although modern physics is tending to show that engineering principles are not fundamental in the constitution of the universe, yet Nature does contrive to produce engineering work on the grand scale, much of which is exemplified in the structure of the stars He then proceeded to amplify this statement by regarding a star as a power station, and considering the questions of its equipment and fuel supply

The latter question is still in a very unsettled state, and although there are strong grounds for accepting provisionally the hypothesis that a star's heat is provided by the destruction of matter inside it, there are some observational results which are hard to reconcile with this The lecture was framed in characteristic language, embodying Prof Eddington's customary charm of expression A typical example is the following statement of the somewhat recondite 'exclusion principle' of modern atomic physics

"In general terms it means that every electron insists on being in some way a little bit different from its neighbours So when pressure tries to insist on electron *A* packing a little closer to electron *B*, *A* replies 'No We are already so nearly in the same position that people can only just manage to tell us apart' But it is open to persuasion by an offer of some other distinction as a substitute for difference of position If *A* differs sufficiently from *B* in energy or in momentum, that will do just as well So at high temperatures when there is plenty of energy to go round, the electrons can distinguish themselves by seizing different quantities of it, and then they will not mind losing their distinction by position Poor things! they are all turned out exactly to pattern by Nature's lathe, so they treasure these ways of insisting on their individuality—not to be just like one's neighbour And so it comes about that at low temperatures the exclusion principle devotes its efforts to separating the electric charges in position and gives a large effective volume to the atom, whereas at stellar temperatures it is more concerned with distinguishing their momenta and energies, and is lax about keeping them apart in position"

Prof Eddington referred to the possibility that a star might be regarded as being in "a rather remarkable state, namely, a crystalline gas" He does not think the gas inside a star is crystalline, but that it is not so far removed from that condition that we can leave the possibility out of all consideration. In any volume inside a star there are a few big positive charges (atomic nuclei) and a relatively much larger number of small negative charges (electrons) The former tend to take up a configuration of minimum energy, which is that of a crystal lattice, while the

latter spread fairly uniformly over the volume The energy of agitation tends to stir the material and 'melt' the crystal, but the crystalline state is a fair approximation to the actual condition The gaseous character of the material would be manifested chiefly in its mechanical properties of expansion and compressibility, while the crystalline structure would appear chiefly in the optical properties

A discussion of Cepheid variables regarded as pulsating stars occupied a considerable portion of the lecture Although the difficulties of the conception have not been completely overcome, Prof Eddington regards them as by no means serious The problems set by such stars have led him to the view that the influence of temperature and density on the rate of liberation of sub atomic energy must be an indirect one 'The energy is released from certain active substances formed inside the star, the rate of formation of these substances increases with temperature and density, but they break up and liberate the energy at a rate unaffected by temperature and density"

Museums and Education

SIR HENRY A MIERS accomplished a great work for the museums of Great Britain when he wrote his report for the Carnegie Trustees, but that report was designed more particularly for museum committees and museum curators, and its appeal was for the specialist rather than the public Now Sir Henry adds a second to his former accomplishment, for he has gone out into the wilderness to preach the gospel of museums to the people This is as it should be, for it is to the apathy of the public and the dislike of intellectual effort, observable even where first rate museums offer no excuse for it, that much of the inefficiency of museums can be traced

On Jan 23, Sir Henry Miers delivered an address on "Museums and Education' to the Royal Society of Arts, when the Right Hon The Earl of Crawford and Balcarres, himself known for his wide interests in museums, was in the chair Readers familiar with the strictures of the report will be prepared to learn that his address was not a gospel out and out, but under lying the very just criticisms which he made of certain types of museums, of curators, and of the public, lay a deep current of optimism in the educational possibilities of museums, and in a rejuvenated future in which they would take their due place in the development of the nation's outlook and thought His address fell into two broad sections in the first, he displayed the weaknesses and inefficiencies of many museums as they now exist, and showed how these had a direct and unfavourable repercussion upon the people's museum outlook In the second, he pointed the way in which steady improvement might be made, by a reorganisation of museums towards special ends

Sir Henry Miers' general criticisms of local museums as they are are familiar to readers of NATURE He summed them up in the course of his lecture "There are many signs of improvement in the general situation, but, when all is said, it must be confessed that the large majority suffer from over exhibition, lack of policy, and the fatal habit of accepting miscellaneous gifts, so that of the service which they might render throughout the country a very small part is actually fulfilled by them"

Perhaps it is more profitable to dwell on Sir Henry's constructive suggestions He founded his proposals on the proper assumption that museums are designed for the use of four distinct categories of visitors the ordinary more or less casual, visitor, the local student, whether he be of ripe years or an elementary scholar, the definite and purposeful collector and inquirer, and the scientific research worker Not every museum can cater for each of these groups, but the principle of appeal for any group ought to be similar wherever it has a place Thus it is most fitting that for the ordinary visitor the nature and resources of the town or district should be displayed, the labelling should be thorough yet simple in word, and easy transitions should lead from one collection to another of different kind

For school children and older scholars, summary collections or introductory series are desirable, and Sir Henry said a true word when he stated that the writing of lucid, accurate, and short labels is a very difficult task, requiring much care and thought, and, we would add, experience For the collector, the introductory series must be supplemented by systematic collections, and for the research worker, to these must be added great stores of classified and authenticated material

A strong appeal was made for the strengthening of the Museums Association, as a correlating body, for the extension of interaction and inter lending between the national and local museums, and for the creation of a type of museum new to Great Britain, the 'folk museum,' which would depict in complete units the life of English (why not British ?) people through the ages

Culture Sequence in the Swiss Lake Dwellings

OWING to lack of supervision and organisation in the earlier explorations of the Swiss lake dwellings, chronological data relating to the finds are scant As, however, investigations were for the most part of a superficial character, many sites were left undisturbed except for the topmost layer Some of these have now been explored by M Vouga under the auspices of the Neuchâtel Committee for Archæological Research A summary of the results is given in *Antiquity* for December

The civilisation of the Swiss lake dwellings up to and including the Copper Age is represented by two phases The older appears in a single stratum, while the second consists of two or three superimposed These are distinguished as lower, middle, and upper Neolithic and Eneolithic ages They are separated each from each by a barren layer of a certain thickness It is to be noted that in the deposit of the first occupation, which always rests on the lacustrine bed, the objects found are for the most part of a much more advanced technique than those found in the upper layers This is particularly true of the pottery, which reaches a high grade of excellence Here, too, the flint is dark brown, semi transparent at the edges, and not the opaque white, dusky, or black local product The spindle whorl seems unknown

The middle Neolithic has been called the *bel âge de la pierre*, but that appellation must now be abandoned in view of the finds in the hitherto neglected lower Neolithic It is, however, still the most important settlement, its deposit sometimes being a metre thick The remains of the habitations have generally been destroyed by fire Its flint work is richer and more varied than in the early stratum, the 'type fossil' being the arrow head The pottery has degenerated, and gives the impression of an art in its infancy

The upper Neolithic is a normal evolution of the middle, of which it represents merely an advanced

phase, though separated from it by a barren deposit As a rule it forms the base of the archæological deposit of the Copper Age, which is found inland, proving that the waters stood at a higher level in the late Neolithic period

The Eneolithic age evolves normally from the preceding Neolithic The fact that the upper strata of this period were disturbed at a very early date points to the cultivation of the ground by the succeeding people of the Bronze Age The occurrence of the Bronze Age dwellings at a greater distance than the Neolithic from the present shore points to a period of drought rather than to greater technical skill

University and Educational Intelligence

Birmingham — The report of the Vice Chancellor to the Council for the year 1927–28, which will be presented to the Court of Governors at the annual meeting on Feb 21, has been issued The number of students for the session showed an increase on that for the preceding year, and a further increase appears in the present session Pleas are advanced for the extension of the residential accommodation for women students, for an increase in expenditure on the library, and for more scholarships with which maintenance grants must be associated The appointment of some senior members of the non professorial staff to Grade I is urged on the ground that if retirement at the age of sixty is compulsory, those who have not held for some ten years a post with a salary of not less than £600 are entitled only to a pension which is quite inadequate to services rendered The Vice Chancellor reports that the voluntary medical examination of women students on entering the University, which was instituted two years ago, has met with complete success, and it is hoped that similar facilities may be offered to men students The report of the Joint Standing Committee for Research records a substantial output of research during the session

Cambridge — A syndicate consisting of the Vice Chancellor, Sir J J Thomson, Master of Trinity Prof Seward Master of Downing College Dr Willis, Dr A W Hill Dr H Hamshaw Thomas Prof A G Tansley, Sherardian professor of botany in the University of Oxford, A Amos, R A Hayes, and F L Engledow has been appointed to consider the organisation and finance of the Botanic Garden and the relations between the Garden and the Department of Botany and other scientific departments, and to report to the University by the end of the ensuing term

Edinburgh — At a meeting of the University Court on Jan 28, Principal Sir J Alfred Ewing intimated his intention to retire from the principalship of the University on Sept 30 next

St Andrews — The Prime Minister, the Right Honourable Stanley Baldwin has been elected Chancellor of the University and has written to Principal Sir James Irvine accepting the appointment

Recently Mr Paul F Williams, a well known engineer and business executive of Chicago, Illinois, established the Paul F Williams Research Foundation Fund for the promotion of scientific research at Purdue University, West Lafayette Indiana This fund provides for several one thousand dollar annual research fellowships At least two of these will be available for physical research in the Graduate School of the School of Science This is but one of the many evidences of the business man's interest in the building of a research centre at Purdue University, where knowledge may be created through fundamental research and applied through industrial research

Calendar of Patent Records.

February 9, 1832 — During the steam carriage boom that started about 1821 and lasted some years, several companies were formed and projected to run lines of coaches The London and Birmingham Steam Carriage Company built in 1833 a coach of the type invented by Dr William Church of Birmingham, and patented by him on Feb 9, 1832 The coach had a single front wheel and was carried on air springs, its driving wheels were 8 ft 6 in in diameter, and had elastic rims and spokes, they were mounted on separate axles and geared by chains to the engine shaft The carriage did not prove very successful and was not used after a few short trials

February 10, 1801 — Green houses for vines and other plants came into general use during the eighteenth century The first patent for a hothouse was granted on Feb 10, 1801 to James Anderson, the editor of the rare periodical *The Bee, or Literary Weekly Intelligencer*, 1791–94, and the author of several agricultural works

On the same day, Feb 10 1801, the first patent for a fire resisting safe was granted to Richard Scott, a colonel in the employ of the East India Company The safe consisted of an outer casing with double walls of metal and a filling of charred wood soaked in an alkaline solution, and an inner metal box supported on all sides by pins

February 10, 1825 — A great improvement was made in the candle by the invention of the plaited wick, which became untwisted and consumed as the candle burnt The invention was patented in France by Cambacérès on Feb 10, 1825, but it does not appear to have reached England until some years later

February 12 1849 — During the first half of last century especially after the invention of photography, the forgery of Bank of England notes was very common and many inventors applied themselves to the problem of devising means to circumvent the forgers and safeguard the public The new issue of notes which was made from the Bank in 1855 was printed on paper manufactured according to a process patented by William Brewer and John Smith on Feb 12 1849 in which the design for the water mark is engraved on steel dies and transferred by stamping to brass plates fitted within the paper making moulds

February 14, 1780 — The well known letter copying press was patented by James Watt on Feb 14, 1780 The patent specification describes, in addition to the usual screw press, a rolling press, which is the form that Watt himself preferred to use

February 14, 1876 — Several claimants, notably Reis in Germany and the Italians Manzetti and Meucci, dispute with Alexander Graham Bell the right to be called the inventor of the telephone, but it was undoubtedly on Bell's experimental work and his United States patent of 1876 that the commercial development of the telephone is based, and from which its use as a practical instrument dates Bell's application for his original patent and a *caveat* from Elisha Gray for a similar invention at which he had arrived independently were filed in the U S Patent Office on the same day, Feb 14, 1876, within an hour or two of each other, but the actual times of filing were sufficiently well authenticated to enable the Patent Office authorities to pronounce definitely in favour of the priority of Bell, and his patent was duly sealed Applications from Gray, Edison, Dolbear, Berliner, and others, followed in quick succession, and heavy litigation was only settled by the Bell Company buying up the whole series of inventions

Societies and Academies.

LONDON.

Royal Society, Jan 31 —**S Chapman** On the theory of the solar diurnal variation of the earth's magnetism A 'drift-current' theory is proposed, which may account for the major part of the solar diurnal magnetic variation, but at present a decision cannot be made between this and the 'dynamo' theory, both theories require that the diurnal convective motion in the conducting layer differs largely in phase from that observed in the lower atmosphere —**G M B Dobson, D N Harrison, and J Lawrence** Measurements of the amount of ozone in the earth's atmosphere and its relation to other geophysical conditions Daily observations of ozone in the upper atmosphere show that there is a well marked area, with much ozone, immediately to the west of cyclones, while ozone is generally small in anti cyclones Polar air currents in upper atmosphere are generally associated with much ozone and equatorial currents with little There is large annual variation in amount of ozone in high latitudes, but very little in low In autumn the amount of ozone is nearly uniform over the hemisphere —**S Chapman and J M Stagg** On the variability of the quiet day diurnal magnetic variation at Eskdalemuir and Greenwich Corresponding daily values of percentage departure of actual from the 'normal' range of diurnal solar magnetic variation (ΔR) for the same element at the observatories are closely correlated, whereas there is much less correlation between corresponding values of ΔR for different elements at the same observatory Actual range (R) or ΔR sufficiently characterises daily variation at any season, because variation is the same, except in scale, on days of large as on days of small range —**L H Gray** The absorption of penetrating radiation Adopting the hypothesis that penetrating radiation is a type of γ radiation, its absorption in the atmosphere is investigated from the theoretical point of view —**R d'E Atkinson** The probability of excitation by electron impact Starting from the quantum theory point of view, a method is developed of analysing the results obtained by the Townsend type of experiment, in which currents of the form $i = i_0 e^{ax}$ are found on varying the distance x between two parallel plates in a gas at comparatively high pressures —**N W McLachlan** Pressure distribution in a fluid due to the axial vibration of a rigid disc Pressure distribution throughout the hemisphere on each side of a rigid disc, vibrating in a circular aperture in a plane wall of infinite extent, is considered When wave length is large compared with diameter of disc, pressure distribution is uniform over any hemispherical surface distant several diameters from disc When wave length is comparable with diameter, pressure decreases with increase in angular distance from axis In general, the central zone is the only one of importance —**J D Cockcroft** Skin effect in rectangular conductors at high frequencies At high frequencies the surface of the conductor becomes a stream line in the magnetic field, and the problem of distribution of current becomes analogous to an electrostatic problem, surface current density corresponding to electrostatic surface density, whilst depth of penetration is the same as for infinite strips —**L Rosenhead** Systems of line vortices in a channel of finite breadth The investigations deal with a Kármán street of vortices, or unsymmetrical double row, in a channel of finite breadth A discussion on the symmetrical double row has also been incorporated —**T P Hilditch and N L Vidyarthi** (1) The products of partial hydrogenation of some higher monoethylenic esters A method has been worked out of determining the constitution of the isomeric acids produced in hydrogenation of derivatives of the oleic series Methyl esters of oleic, palmitoleic and erucic acids each yield a mixture of three position isomerides, namely, the original acid, and the two acids in which an ethylenic linkage is in either of the positions adjacent to that originally occupied The bearing of this upon the general theory of contact action at solid surfaces is considered, the opposite geometrical isomeride of original ethenoid acid, and also formation of position isomers, seem to be due to dehydrogenation of freshly formed saturated ester prior to desorption from catalyst —(2) The products of partial hydrogenation of some higher polyethylenic esters. The various ethenoid bonds are not usually hydrogenated at same rate, and the isomerisation phenomena discussed above are encountered These complications are not sufficient seriously to interfere with the utility of the method as a means of determining constitution of polyethylenic derivatives —**P K Kichlu and D P Acharya** Infra red radiations of active nitrogen Photographic investigation of the spectrum from λ7500 to λ8900 shows that it is an extension of the first positive group of nitrogen in the green, yellow, and red regions The most important group of lines of atomic nitrogen at about λ8200 is absent —**T H Havelock** The vertical force on a cylinder in a uniform stream The method of successive images, taking images alternately in surface of cylinder and in free surface of stream, is used The method can be applied to any submerged body for which image systems are known —**R C J Howland** Stress systems in an infinite strip —**A H Wilson** Perturbation theory in quantum mechanics The convergence of the series of perturbations is discussed Though the series is not in general convergent, yet it usually possesses an asymptotic character, and its use is therefore justified —**O W Richardson and K. Das** The spectrum of H_2 the bands analogous to the orthohelium line spectrum —**O W Richardson and P M Davidson** The singlet bands of the hydrogen molecule (1) The strongest two band systems in the spectrum of H_2 belong to 3 to 2 electron transitions analogous to those of the parhelium line spectrum The properties of the final state are given with great accuracy

Linnean Society, Jan 3 —**C E Moss** A new genus of the Hydrocharitaceæ from the Zambezi The freshwater plant discussed was collected in the River Zambezi, at its confluence with the River Linyanti, at Kazangula, above Livingstone, in Rhodesia It was growing, staminate plants here and pistillate plants there, on the water margin of a reed swamp, in water about three metres deep Apart from the flowers, the whole plant was submerged The petals are broad, the stamens number twelve, and are of four different sizes, six staminodes, three large filament like ones and three small scale like ones, occur in the pistillate flower Moreover, the new plant is remarkable by its elongate and ligulate leaves, its elongate and terete peduncles, and its cylindrical and monophyllous spathes all covered with soft conical projections The plants appear to be identical with the type-specimen of *Boottia muricata* Wright

PARIS

Academy of Sciences, Jan 7 —**A Lacroix** The existence of tectites at Cambodia their morphology A résumé of the results of the examination of 1760 specimens, giving an account of the shape, fracture, and markings The question of origin is reserved for later discussion.—**E Fichot** The extension of the method of geographical engineers to terms of the fourth order —A. Stodola was elected *correspondant* for the Section of Mechanics, and William Bowie *correspondant* for the Section of Geography and

Navigation —**Paul Delens** Spherical operations and paratactic congruence —**Ch Bioche** Ruled surfaces having skew cubics for asymptotes —**V Smirnoff** The limit values of analytical functions —**Soula**: The comparison of various theorems on Taylor's series —**O D Kellogg and Florin Vasilesco** Contribution to the study of the capacity and of Wiener's series —**A Demoulin** A class of congruences —**Jules Drach** The transformation of partial differential equations of the second order by the explicit use of the characteristic variables of Ampère —**Arnaud Denjoy** A class of analytical functions —**Alexandre Kovanko** The approximation of generalised nearly periodic functions —**A Gay** The slow, non permanent movement of any cylinder in a viscous incompressible liquid —**Ernest Esclangon** Experiments in optical reflection and the asymmetry of space —**Ludovic Gaurier** Limnological studies in the French Pyrenees —**Th De Donder** The photonic field and the relativist generalisation of the undulatory mechanics of Dirac —**A F Joffé and A N Arsénieva** Experiments on the polarisation of electronic waves The negative results from these experiments concerning polarisation either by reflection or by the magnetic field are in full agreement with the undulatory theory of matter developed by C G Darwin and by J I Frenkel —**J Frenkel** The impossibility of polarising the cathode rays by reflection —**Henri Gutton** The properties of ionised gases in high frequency fields —**Jean Thibaud** The effect of periodic concentration and expansion produced by a longitudinal magnetic field on a bundle of slow electrons The effects produced on the trajectory of a bundle of slow electrons passing through the magnetic field produced by a coil carrying a continuous current resemble those produced on a ray of light passing through a lens, the convergence of which varies continuously —**Léon and Eugène Bloch** Inter combinations and new terms in the spark spectrum of sulphur, S II —**J Dufay** The absorption spectrum of oxygen and of ozone in the ultra violet region —**V Dolejšek and K Pestrecov** The tendency of the values of the discontinuities of the K absorption of the simple bodies —**Henri Belliot** Influence of the nature of the fixer on the development after fixing of inverted or solarised photographic plates —**P Dejean** The study of mechanical properties as a means of following the transformations of brasses containing 57 5 63 5 per cent of copper Crushing tests at varying temperatures up to 900° C have been carried out and the results given in a graph in which the crushing strength is plotted against temperature for several alloys The curves show a point of inflection at 475° C common to all the alloys, and a higher point, 685° 783° C, varying with the composition of the alloy —**Albert Roux and Jean Cournot** The internal transformations of a copper aluminium alloy Details of X ray studies of a copper aluminium alloy (90 copper, 10 aluminium) after various kinds of heat treatment —**Pierre Jolibois** The application of the theory of Smits to the allotropic varieties of phosphorus The author contends that this theory, although attractive, is not in accord with the known facts concerning the allotropic varieties of phosphorus It is regarded as proved that there are four varieties of solid phosphorus, namely, white phosphorus, ordinary red phosphorus, pyromorphic phosphorus and Bridgmann's black phosphorus —**Clément Duval** A cobaltic monammine Werner has classified the cobaltiammines in seven series containing decreasing quantities of ammonia Up to the present, no example has been known of the type ($Co\ NH_3\ X_5$) M_2 The preparation of a representative of this series is described, sodium cobalti ammonioborate ($Co(BO_2)_5NH_3)Na_2$ —**R. Locquin and V Cerchez**: Some derivatives of hydantoinacetic acid —**Max and Michel Polonovski** 8 Chlorotropane and the non-existence of Hesse's bellatropine —**J Orcel and Gil Rivera** The microscopic study of the complex copper silver minerals of Colquijirca (Peru) —**Robert Gibrat** The variation with direction of the capillary constant of smectic bodies An application of the Gauss theory of capillarity to smectic bodies —**Maurice Blumenthal** The succession and distribution of the tectonic units of the Mediterranean slope of the Betic Cordilleras between Grenada and Gibraltar —**G Nicolas** An endophyte of *Lunularia cruciata* —**N N Kourtiakoff** The influence of the relief of the soil on fertility —**P Mazé and P Evens** Chlorosis in cultures on land under sewage irrigation its cause and cure This can be remedied by addition of iron salts —**Harald Okkels** The existence of a morphological specialisation at the level of the vascular pole of the renal glomerule in the frog —**J André Thomas** The reactions of grouped living beings The action of some alkaloids on *Convoluta Roscoffensis* —**F Holweck** The production of monochromatic X rays of great wave length Quantitative action on micro organisms Study of the action of X rays of 4 8 A on the pyocyanic bacillus The results for rays of 4 A and 8 A are shown on separate curves and compared with the calculated curves —**A Lacassagne** The action of X rays of great wave length on micro organisms The establishment of exact statistics of the mortality of the irradiated bacteria A discussion of the technique necessary for exact determinations —**Mme P Curie** The study of the probability curves relating to the action of the X rays on bacilli A mathematical discussion of the matter in the two preceding papers —**S Mutermilch and Mlle E Salamon** The local formation of antitoxins in the cephalo rachidian fluid The vasculo meningeal barrier is impermeable to blood antitoxins formed in the animal organism as the result of the inoculation of anatoxins in the peritoneal cavity The appearance of antitoxins in the cephalo rachidian fluid of animals vaccinated by the intra meningeal method is due to their local production by cells the nature of which has still to be ascertained —**Georges Tixler** The spectrographic verification of the activation of ergosterol under the influence of irradiation by ultra violet rays The curve of transmission of the ultra violet rays and the curve of antirachitic activity, considered as a function of the time of irradiation, are parallel at first, and then deviate from each other as the time increases The maximum of antirachitic activity does not correspond with the minimum transparency

Leningrad

Academy of Sciences (*Comptes rendus*, No 23) —**A A Belopolskij** Changes in the spectrum of the star α^2 in the constellation Canes Venatici Observations of variations in the intensity of certain lines in the spectrum —**N Gajevskaja**: Some new pelagic infusoria from Lake Baikal Descriptions of three new genera and four new species —**C Flerov** The diagnostic characters in the genus *Capreolus* Frisch (fam Cervidæ) Revised diagnoses of the genus and of its two species, *Capreolus capreolus* (Linn) and *C pygargus* (Pallas), the latter with three subspecies —**J Gueronimus** The multiple polynome deviating least from the zero and with two first coefficients given —**B Schtylko** A method of determination of fossil remains of Teleostei In many cases it is possible to use for the identification of fragmentary fossils of Teleostei the shape and sculpture of scales; several examples are analysed.

Official Publications Received.

BRITISH

The University of Manchester The Manchester Museum Museum Publication 96 Report for the Year 1927-28. Pp 26 (Manchester) 6d. net.

Proceedings of the Royal Society Series A, Vol. 122 No. A789 Pp. 869. (London Harrison and Sons Ltd) 12s.

Ministry of Health Treatment of Tuberculosis Analysis of Work done during the Year 1927 under the Schemes of Local Authorities for the Treatment of Tuberculosis as shown in the Returns furnished in accord ance with Memorandum 37/T (Memo 131a/T) Pp 7 (London Ministry of Health)

Air Ministry Aeronautical Research Committee Reports and Memoranda. No 1167 (Ae 331) Photographs of Streamers illustrating the Flow around an Airscrew in the Vortex Ring State By C N H Lock (T 2583) Pp 4+7 plates 1s net No 1177 (Ae 341) A Brief Survey of Wing Flutter, with an Abstract of Design Recommendations By R A Frazer and W J Duncan (T 2592 T 2635) Pp 31 1s. 3d net. (London H M Stationery Office.)

Malta Annual Report on the Working of the Museum Department during 1927 28 Pp xx (Malta Government Printing Office)

Journal of the Chemical Society containing Papers communicated to the Society December Pp iv+3001 3308+x, (London)

Annual Report of the Indian Central Cotton Committee, Bombay for the Year ending August 31st 1928 Pp ii+118+4 plates. (Bombay) 2 rupees

Survey of India. Map Publication and Office Work from 1st April 1927 to 31st March 1928 Pp vi+19+5 maps (Calcutta.) 1 rupee 1s 9d

Union of South Africa Botanical Survey of South Africa Memoir No. 12 Botanical Survey of the Springbok Flats Transvaal By Ernest E Galpin Pp vi+100+22 plates, (Cape Town Cape Times, Ltd)

Bothalia a Record of Contributions from the National Herbarium Union of South Africa, Pretoria Edited by Dr I B Pole Evans Vol 2 Part 2 November 30th Pp 371 474 (Pretoria.) 7s 6d

FOREIGN

United States Department of Agriculture Technical Bulletin No 81 The Hessian Fly in California By C M Packard Pp 26 (Washington D C Government Printing Office) 5 cents

Meddelanden från Statens Skogsförsöksanstalt Häfte 24 1927 28 Pp iii+88 (Experimentalfältet.) 8 kr

Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia Verhandelingen No 21 Sea Surface Temperatures on some Steamer Routes in the Malay Archipelago By Dr H P Berlage Jr Pp 54 (Weltevreden Landsdrukkerij)

Regenwaarnemingen in Nederlandsch Indië. Negen en veertigste Jaargang 1927 Pp ii+181 (Weltevreden Landsdrukkerij)

Conseil Permanent International pour l Exploration de la Mer Rapports at procès verbaux des réunions Vol 49 Procès verbaux (juin 1928) Pp 175 Vol 51 La pêche littorale sur les côtes de Belgique Par G Gilson Pp. 178 (Copenhague Andr Fred Høst et fils)

Report of the Aeronautical Research Institute Tôkyô Imperial University No 45 Some Problems of Shocks transmitted in Bars and in Plates By Katsutada Sezawa. Pp 83 147 (Tôkyô Koseikai Publishing Office) 0 65 yen

Scientific Papers of the Institute of Physical and Chemical Research No 164 Die quantentheoretische Deutung der grünen Nordlichtlinie auf Grund interferometrischer Feinaneffektmessung Von I A Sommer Pp 181 201 30 sen No 165 On the Oxidation of Ferrous Hydroxide in Sodium Hydroxide Solution by Means of Air By Susumu Miyamoto Pp. 203 208 15 sen No 166 Anomalous Dispersion and Absorption of Electric Waves (continued) By San ichiro Mizushima Pp 209 231 35 sen No 167 Über das Krötengift Mitteilung 8 Über giftige Bestandteile des Sekrets der japanischen Kröte Von Munio Kotake Pp. 233 280 15 sen (Tokyo Iwanami Shoten)

Field Museum of Natural History Anthropological Series Vol 18 No 1 The Prehistory of Aviation By Berthold Laufer (Publication 253) Pp 96+1 plates. (Chicago Ill)

Proceedings of the United States National Museum Vol 74 Art 4 Two new Nematode Worms from Rodents By Emmett W Price (No 2749) Pp 5+2 plates Vol 74 Art 12 A new Polychaetous Annelid of the Genus Phyllodoce from the West Coast of Costa Rica By Aaron L Treadwell (No 2757) Pp 3 (Washington D C Government Printing Office)

Anuario del Observatorio Astronomico de Madrid para 1929 Pp 488 (Madrid Instituto Geográfico y Catastral)

Journal of the Faculty of Agriculture Hokkaido Imperial University Sapporo Japan Vol. 23, Part 1 Chemical Studies on Sex Differences of Proteins in Animals and Plants (Second Report) I Sex Differences of Muscle fibre (Sarkolemm) II Sex Differences of Muscle Proteins By T Tadokoro, M Abe and S Watanabe Pp. 27 (Tokyo Maruzen Co Ltd)

Diary of Societies

FRIDAY, FEBRUARY 8

ROYAL SOCIETY OF ARTS (Indian Meeting) at 4 30 —Capt. E J Headlam The History of the Indian Marine

ROYAL ASTRONOMICAL SOCIETY (Anniversary Meeting), at 5 —Presentation of the Gold Medal to Prof E Hertzsprung for his Determination of the Distance of the Lesser Magellanic Cloud and other Pioneering Work in Stellar Astronomy

PHYSICAL SOCIETY (at Imperial College of Science), at 5 —I F Stanley The Construction and Calibration of a Sensitive Form of Pirani Gauge for the Measurement of High Vacua.—H C Webster (a) Photographic Measurement of the Relative Intensities of the $L\alpha_1$, $L\alpha_2$ $L\beta_1$ Lines of Silver, (b) Spark Satellites of the $L\alpha$ Lines of Silver —Demonstration of a New Instrument for the Rapid and Accurate Determination of the Specific Gravities of Solid Substances by W A Benton

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 —Prof R. T Payne The Treatment of Varicose Veins and Varicose Ulcers by Injection

ROYAL SOCIETY OF MEDICINE (Clinical Section), at 5 30

BRITISH PSYCHOLOGICAL SOCIETY (Æsthetics Section) (at Bedford College for Women), at 5 30 —Dr H Lowery Musical Memory and Rhythm

MALACOLOGICAL SOCIETY OF LONDON (Annual General Meeting) (at University College) at 6 —Prof A. E Boycott The Ecology of British Land Mollusca

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting) at 6 —I A Legros and others Discussion on The Profession of the Mechanical Engineer

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Newcastle-upon Tyne), at 6.—Dr G W Todd The Prediction of the Properties of Engineering Materials from their Ultimate Structures

INSTITUTION OF ELECTRICAL ENGINEERS (London Students Section) at 6 15 —H H Taylour Electric Welding

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Informal Technical Talk), at 7 —B C Wickison Lantern Slides

GEOLOGISTS ASSOCIATION (Annual General Meeting) (at University College) at 7 30 —Prof A. Morley Davies Formal Migrations since the Cretaceous Period (Presidential Address).

INSTITUTE OF METALS (Sheffield Local Section) (at Sheffield University) at 7 30 —W T Griffiths Some Recent Developments in Nickel Metallurgy

JUNIOR INSTITUTION OF ENGINEERS at 7 30 —Dr A E Dunstan Recent Developments in the Art of Oil Cracking (Lecture).

BLACKBURN TEXTILE SOCIETY (at Blackburn Technical College), at 7 30 —S. Kershaw The Production of Worsted and Mixed Yarns

TEXTILE INSTITUTE (Lancashire Section) (at Harris Institute Lancaster) at 7 30 —W B Crompton Some Post War Changes in Lancashire Cotton Mills

KEIGHLEY TEXTILE SOCIETY (at Keighley) at 7 30 —K. A Mountain and A B Maclean Comparative Advantages of Private Plant and Purchased Power

LEICESTER TEXTILE SOCIETY (at Leicester), at 7 30 —T A Holroyd Hosiery Dyeing Operations

SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (at Royal Society of Arts), at 8 —Prof W E Gibbs The Rôle of Surface Energy in Chemical Engineering

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section) at 8 30 —R. F Moore and Mr Scott Clinical and Pathological Report of Bilateral Glioma Retinæ —R F Moore Cirsoid Aneurysm of the Visual Cortex —B Graves Scleral Illumination

ROYAL INSTITUTION OF GREAT BRITAIN at 9 —C E R Sherrington Recent Problems of Rail Transport at Home and Abroad

SATURDAY, FEBRUARY 9

MINING INSTITUTE OF SCOTLAND (at 79 Grassmarket Edinburgh), at 5 —Prof H Briggs (a) The Mineralogy of Coal (b) The Appearance of Coals etc in Ultra Violet Rays.—J B Sneddon The Mining Congress in Canada in 1927 —Papers open for discussion —Some Impressions of German Mining, D C Gemmell and J Heron —Trolley Wires Ropes and Trolley Fittings A T Adam —Pavement Brushing versus Roof Brushing I S Frame

ROYAL INSTITUTION OF GREAT BRITAIN at 3 —Dr S Marchant Music in Cathedral and Collegiate Churches (I)

MONDAY FEBRUARY 11

CAMBRIDGE PHILOSOPHICAL SOCIETY (in University Chemical Laboratory) at 4 30 —Prof T M Lowry Configuration of Quadrivalent Atoms —Dr F G Mann The Stability of Complex Metallic Salts —Dr F H Constable An Apparatus for the Study of Gas Reactions on Electrically Heated Films of Known Area —C I Snow The Structure of the Nitric Oxide Molecule

ROYAL GEOGRAPHICAL SOCIETY (at Lowther Lodge) at 5 —Capt F R L Peake The Tavistock Theodolite

ROYAL COLLEGE OF SURGEONS OF ENGLAND at 5.—Prof H A Harris Bone Growth in Health and Disease

INSTITUTION OF AUTOMOBILE ENGINEERS (Birmingham Centre) (at Queen s Hotel Birmingham) at 7 —Dr F W Lanchester Coil Ignition

INSTITUTION OF ELECTRICAL ENGINEERS (North Eastern Centre) (at Armstrong College Newcastle upon Tyne), at 7 J Wright and C W Marshall The Construction of the Grid Transmission System in Great Britain

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associates and Graduates Branch) (London and District) (at Borough Polytechnic) at 7 30 —J I Kinnell Jr Cast Iron

MEDICAL SOCIETY OF LONDON at 8 —Dr M McCrea and H Tilley Earache

INSTITUTION OF ELECTRICAL ENGINEERS (Western Centre) (at Bristol)

TUESDAY FEBRUARY 12

ROYAL INSTITUTION OF GREAT BRITAIN at 5 15 —Prof J S Huxley Evolution and the Problem of Species (III).

INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5.30 —J S Parker and C A P Southwell The Chemical Investigation of Trinidad Well Waters and its Geological and Economical Significance

INSTITUTION OF PETROLEUM TECHNOLOGISTS (Students Section) (at Birmingham University), at 5.30 —H M Stanley The Production of Gaseous Liquid and Solid Hydrocarbons from Methane Thermal Decomposition of Methane Part I

INSTITUTE OF MARINE ENGINEERS at 6 30 —G J Scott The Design and Construction of Electric Auxiliaries for Marine Services.

ELECTRICAL ASSOCIATION FOR WOMEN (at 15 Savoy Street) at 7 —H de A Donisthorpe Radio Progress and its Connexion with the Thermionic Valve

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole Leeds), at 7 —E B Wedmore Dr W B Whitney, and C E R. Bruce An Introduction to Researches on Circuit Breaking

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—H M Cartwright The Limitations of Colour Photography

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch Burnley Section) (at Municipal College Burnley), at 7 15.—Mr Griffiths Some Aspects of Modern Foundry Practice.

INSTITUTION OF AUTOMOBILE ENGINEERS (Coventry Centre) (at Rover Sports Club Coventry), at 7 30 —Dr F W Lanchester Coil Ignition.

INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at Royal Technical College Glasgow), at 7 30.—W B. Woodhouse Overhead Electric Lines

INSTITUTE OF METALS (North East Coast Local Section) (at Armstrong College, Newcastle upon Tyne), at 7 30 —J E Newson Metallurgy of Engineering.

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Middlesbrough Branch) (at Cleveland Scientific and Technical Institution, Middlesbrough), at 7 30 —G B Butler The Manufacture of Steel as applied to Shipbuilding and Engineering

QUEKETT MICROSCOPICAL CLUB, at 7 30 —Annual General Meeting

LIVERPOOL GEOLOGICAL SOCIETY (at Royal Institution, Liverpool) at 8.—Prof H. L Hawkins Revolutions and their Effect on Life (Lecture).

ROYAL SOCIETY OF MEDICINE (Psychiatry and Neurology Sections) (*also on Feb 14*), at 8 30 —Dr W H. B Stoddart (Psychiatry), Sir James Purves-Stewart (Neurology), and others Special Discussion on Prognosis and Treatment of General Paralysis of the Insane

NELSON TEXTILE SOCIETY (at Nelson).—J Kershaw Fancy Effect Yarns.

MANCHESTER ATHENÆUM TEXTILE SOCIETY (at Manchester) —B E. Canney Economic Question of Vital Importance to the Cotton Trade.

WEDNESDAY, FEBRUARY 13

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Annual General Meeting) (at Holborn Restaurant), at 2 30 —J R Preston Presidential Address.—H G Cathcart Water Softening by the Base Exchange Process.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 —Prof H A Harris Bone Growth in Health and Disease

ROYAL SOCIETY OF MEDICINE (Surgery Sub-Section of Proctology), at 5 30 —W B Gabriel Case of Carcinoma of the Rectum Complicated by Enlarged Prostate —Dr P H Manson Bahr Pathology of Bilharzia and Amœbic Dysentery of Colon and Rectum —R. Maingot Three Cases of Acute Intestinal Obstruction due to Fæcal Impaction – A. L. Abel Three Cases of Multiple Cancers of Rectum and Colon.

INSTITUTION OF CIVIL ENGINEERS (Informal Meeting), at 6 – H P Gase Merits of Alternative Methods of Driving Auxiliaries in Modern Power Stations.

INSTITUTE OF METALS (Swansea Local Section) (at Thomas Cafe Swansea), at 7 —J E Malam Recent Developments in Rolling Metal Strip and Sheet.

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section) (at Bolbec Hall Newcastle-upon Tyne), at 7 15 —F H Todd Ship Trials and their Analysis

HALIFAX TEXTILE SOCIETY (at Halifax) at 7 30 —G Shackleton Weaving of Fancy Cloths

ROYAL PHILOSOPHICAL SOCIETY OF GLASGOW (at 207 Bath Street, Glasgow) at 8.

ROYAL SOCIETY OF ARTS, at 8.—C Hooper The Pollination of Fruit Blossoms and their Insect Visitors

EUGENICS SOCIETY (at Linnean Society), at 8 —Mrs M Hawkes, Dr Drysdale and others Discussion on Democracy and Heredity

ELECTROPLATERS AND DEPOSITORS TECHNICAL SOCIETY (at Northampton Polytechnic Institute), at 8 15 —S. Wernick The Electrodeposition of Cadmium for Rust Prevention

INSTITUTION OF MECHANICAL ENGINEERS (Glasgow Branch).—Prof A. S Eddington Engineering Principles in the Machinery of the Stars (Thomas Hawksley Lecture)

TEXTILE INSTITUTE (London Section).—G A Rushton and others Informal Discussion on Identification of Textile Fibres.

THURSDAY, FEBRUARY 14

IMPERIAL COLLEGE CHEMICAL SOCIETY (jointly with Royal College of Science Mathematical and Physical Society) (at Royal College of Science) at 5 —Prof G I Finch Electro-metallurgy (Public Lecture).

LINNEAN SOCIETY OF LONDON at 5 —E E Edwards On the Morphology of the Larva of *Dorcus parallelopipedus* L —E Taylor Exhibition of Lantern slides of Scottish Plants.—R S Bose Biology of Wood rotting Fungi —A G Lowndes Lantern slides of Edge Island Greenland Variation in Arctic Freshwater Entomostraca.

LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5 —Prof O Veblen Generalised Projective Geometry (Lecture).

ROYAL SOCIETY OF MEDICINE (Balneology Section), at 5 —Discussion on Osteo-arthritis —Dr R. G Gordon Dr J A. Thomson Osteo-arthritis Radiographically Considered —Dr T Hare and Dr H Cohen The Chemical Estimation of Synovial Fluid and Blood Serum of Horses Affected with Chronic Arthritis

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15—Sir William Bragg The Early History of X rays (III).

BIOCHEMICAL SOCIETY, BIRMINGHAM UNIVERSITY at 5.30 —Prof J C Drummond Problems of Vitamin Research

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—W Cruickshank Voice-frequency Telegraphs

ROYAL AERONAUTICAL SOCIETY (jointly with Institution of Automobile Engineers) (at Royal Society of Arts), at 6.30 —A. H. R. Fedden Air cooled Engines in Service

SOCIETY OF CHEMICAL INDUSTRY (Birmingham and Midland Section) (at Engineers Club, Birmingham), at 7 —D W Parkes Disposal of Ammonia Liquors

SOCIETY OF CHEMICAL INDUSTRY (Bristol Section) (at Bristol University), at 7 30 —Dr C. A. Edwards Some Chemical Aspects of Tinplate Making

INSTITUTION OF ELECTRICAL ENGINEERS (Dundee Sub-Centre) (at University College, Dundee), at 7 30.—W B Woodhouse Overhead Electric Lines.

INSTITUTE OF METALS (London Local Section) (at 83 Pall Mall), at 7 30 —Some Present-Day Metallurgical Tools and Methods —Dr C. J Smithells: The X-ray Spectrometer —S. V Williams Quantitative Spectroscope Analysis —H. Wrighton: High Magnification Microscopy —W. E Prytherch Dilatometers. —A. J Murphy Preparation of Some Unusual Metallographic Specimens.

INSTITUTE OF METALS (Scottish Local Section, jointly with Institution of Engineers and Shipbuilders, and Institute of British Foundrymen) (at 39 Elmbank Crescent, Glasgow), at 7 30.—Dr W Rosenhain Alloys—Past, Present, and Future.

OPTICAL SOCIETY (at Imperial College of Science), at 7.30 —Dr D S. Perfect An Application of the Interferometer to the Goniometry of Prisms —Demonstration of Prof Coker s Photo-Elastic Apparatus (1928 Model) by Adam Hilger, Ltd.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemistry Section) (jointly with Leicester University College Biological Society) (at Leicester University College), at 8.—Prof E. C C Baly The Photo-synthesis of Carbohydrates from Carbonic Acid

BRITISH INSTITUTE OF RADIOLOGY, at 8.30

BATLEY AND DISTRICT TEXTILE SOCIETY (at Batley).—W F Vickers Oils and Wool

INSTITUTION OF MECHANICAL ENGINEERS (Leeds Branch).—Prof A. S Eddington Engineering Principles in the Machinery of the Stars (Thomas Hawksley Lecture).

INSTITUTION OF MECHANICAL ENGINEERS (Manchester Branch).

FRIDAY, FEBRUARY 15

GEOLOGICAL SOCIETY OF LONDON, at 3 —Annual General Meeting

ROYAL ASTRONOMICAL SOCIETY (Geophysical Discussion), at 4.30.—Geophysical Methods in Surveying. Chairman Sir Gerald Lenox Conyngham. Speakers Mr Broughton Hedge, Dr W F P McLintock, and others.

BRITISH INSTITUTE OF RADIOLOGY (Medical Members), at 5 —Informal Discussion on Chest.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 —Prof H. A. Harris Bone Growth in Health and Disease

INSTITUTION OF MECHANICAL ENGINEERS (Annual General Meeting), at 6 —H J Ward Refrigeration on Ship-board

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group—Informal Meeting), at 7 —Discussion on the Stephan H. Tyng Foundation Prints

JUNIOR INSTITUTION OF ENGINEERS, at 7 30.—E G Ritchie Steam Storage

ROYAL SOCIETY OF MEDICINE (Electro-Therapeutics Section), at 8 30.—Discussion on Chronic Rheumatism of Joints and Muscles Diagnosis and Treatment

ROYAL INSTITUTION OF GREAT BRITAIN at 9 —Dr E K. Rideal Chemiluminescence

SOCIETY OF DYERS AND COLOURISTS (Manchester Section, jointly with Manchester Section of Oil and Colour Chemists Association) (at Manchester) —F Scholefield The Ostwald Colour System.

SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) (jointly with all Glasgow Chemical Societies) (at 207 Bath Street, Glasgow).—Prof G T Morgan Chemical Studies of Coal Tar Products.

SATURDAY FEBRUARY 16.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr E. Bullock Music in Cathedral and Collegiate Churches (II)

EUGENICS SOCIETY (at Rembrandt Hotel Brompton Road), at 7 30 —Major L. Darwin The Coming of Age of the Society (Galton Lecture).

PHYSIOLOGICAL SOCIETY (at Birmingham University).

PUBLIC LECTURES

FRIDAY, FEBRUARY 8.

LONDON SCHOOL OF ECONOMICS at 5 —C E R. Sherrington Railway Electrification and the Redistribution of Industry

SATURDAY, FEBRUARY 9

HORNIMAN MUSEUM (Forest Hill), at 3.30.—H. N Milligan Life Beyond the Low Tide Mark

MONDAY, FEBRUARY 11

KING S COLLEGE OF HOUSEHOLD AND SOCIAL SCIENCE, at 5 15 —Prof G S. Gordon The Lives of Authors

UNIVERSITY OF LEEDS, at 5 15 —Prof C Lovatt Evans The Principle of Adaptation in Physiology

UNIVERSITY COLLEGE, at 5 30.—Prof J G Andersson Archæological Research in China. (Succeeding Lectures on Feb 13 and 15)—Dr J Bonar Demography in the 17th and 18th Centuries (Newmarch Lectures). (Succeeding Lectures on Feb 18 25, Mar 4, 11, and 18.)

EAST ANGLIAN INSTITUTE OF AGRICULTURE (Chelmsford), at 7 —Prof. J A. Hanley Grassland Management.

TUESDAY FEBRUARY 12

IMPERIAL COLLEGE—ROYAL SCHOOL OF MINES, at 5 30 —F L Engledow Plant Breeding. (Succeeding Lectures on Feb. 14, 19, and 21)

UNIVERSITY COLLEGE, at 5.30.—Dr G M Morant The Rhodesian Man and his Relationship to other Types of Man

THURSDAY, FEBRUARY 14.

BEDFORD COLLEGE FOR WOMEN, at 5.15. —J E. Quibell Egyptian Architecture.

FRIDAY, FEBRUARY 15.

LONDON SCHOOL OF ECONOMICS, at 5.—C E. R. Sherrington Motor Transport and Urbanisation of the Countryside.

SATURDAY, FEBRUARY 16.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss I. D Thornley: Travel and Travellers in the Middle Ages.

SATURDAY, FEBRUARY 16, 1929

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Forests and the Royal Commission on Agriculture in India

SEVERAL aspects of the Report of the Royal Commission on Agriculture in India have already been commented upon in NATURE (July 24 Aug 4 and Nov 17 1928) The position of forestry in the different Provinces is dealt with in the appropriate sections and the evidence before the Commission has recently been published Perhaps the first point which strikes a forester after reading the chapter on forests in the Report of the Commission is the Commission s apparent acceptance of the definition of forest as areas producing large timber Many of the forests of the plains the Commissioners remark are forests only in name Few timber trees are to be found in them but they provide a certain amount of fuel and grazing It is to be hoped that this definition will not come to be accepted for the forests of the British Empire

In the most intensively managed forests in some European countries the definition of forests includes both categories and it has come to be recognised as the result of much bitter and costly experience that the management of the second category the fuel and grazing grounds is often the most difficult It cannot be left to either the village community or to the civil officers For the efficient management and improvement of such forest areas the highest professional talent coupled with administrative experience and great tact is required It is for this reason that we find in some parts of Europe senior executive officers possessed of these attributes delegated to the charge of forest areas forests only in name as the Commissioners term them of which the sole reason of maintenance is the provision of fuel and grazing for the agriculturist In fact such forest areas for they are unquestionably accepted as forests coming within the work of a Forest Department are as necessary for the well being of the agriculturist as the big timber forests the produce of which is required for the industrial sections of the community

In connexion with the timber forests it is stated with truth that the bulk of the areas are inaccessible to the vast majority of cultivators This is an obvious fact (not restricted to India alone) and the inevitable aftermath of ill regulated expansion of agricultural lands in the past with no due provision being made by the reservation of blocks of forest in suitable positions even though situated on land adapted to agriculture This has been the history of the past development of agricultural India Between the sixties and eighties of last century,

forest officers often directed attention to the point, but their voices went unheard when balanced against the clamour for the land and the revenue to be obtained from it by the development of agriculture It is, however, incorrect to state that the distances of the timber forests and the difficulties of transport "result in the great mass of the agricultural population deriving little or no direct benefit from the forests proper" In many countries, the main forests nowadays are situated in the hilly regions and serve to protect the sources and catchment areas of the chief rivers and their tributaries The agriculturist in the plains is directly dependent upon the water from these areas, although, as often in India, he may be situated several hundred miles distant The maintenance of an even flow in the rivers and in the spring level of the underground water which feeds innumerable tanks and wells used for watering the crops in India would certainly undergo a drastic change for the worse were the distant timber forests to disappear

The observations, questions asked of witnesses, the deductions arrived at by the Commissioners, and their recommendations on the subject of the forests in their relation to agriculture, are of considerable importance, since the latter forms the basic industry of the country Briefly, the chief subjects considered may be enumerated as grazing, fuel requirements and their nature, and the question of the formation of forest areas, the object of which should be the provision of grazing and fuel on a regulated basis of management There is much else in the Report of interest to the forester, but here we confine ourselves to the three points mentioned

The Commission devoted considerable attention to the forest grazing business and to the efforts which had been made by cutting and baling grass from the forest to induce the villagers to make use of the dry grass instead of taking the cattle out daily to the forest So far, the villager has persistently refused to make use of baled grass or to alter his age long customs He accepts it as an inevitable ration in times of famine when distance precludes him from sending his cattle to the forests, which are thrown open to all the animals which can reach them In many forests of the country, serious harm has resulted from the excess grazing of animals in the forest, under which all young growth is browsed and the soil becomes beaten down and hardened under the hoofs of successive generations of animals "It is," say the Commissioners, "from the Forest Department more than any other that complaints are heard of overstocking of grass land with animals of no economic value, for this is a subject that is being constantly forced upon their notice in the extensive grazing areas under their control" The forest officer, perforce, sees most of this grazing business, since he has to provide for the animals But it is surely an anomaly to fix the responsibility for the failure of the villager to make use of baled grass or to improve his herd of animals upon the forest officer, and yet successive famine and agricultural commissions, etc, have done so in this matter of cattle and grazing

The forest officer is, however, not responsible for the village or villagers and their agricultural methods The onus in this respect lies with the agricultural departments, and in earlier days rested entirely upon the civil district officer The remarkable increase in the numbers of the cattle, sheep, and goats throughout the country, following upon the settled order introduced and maintained by the British, could not perhaps have been foreseen, but whenever the question has come up during the past half century, those who should have been responsible for the development of agriculture in all its phases, including animal husbandry, simply followed the old methods of the natives, and the forest officer was ordered to make provision for grazing, which each decade became heavier, once the villager had entirely destroyed, by over utilisation, the grazing lands in his vicinity

The Commissioners accept, however, the continuance of forest grazing "Since," they write, "it cannot be doubted that grazing in forests will, for a very long time to come, be an important feature of forest economy, we consider it essential that the intensity of grazing, consistent both with the proper development of the forest and the preservation of desirable grasses, should be determined as soon as possible The Chief Conservator of Forests in the United Provinces informed us that knowledge in both these respects is at present defective" Yet, it may be pointed out, the answer was supplied (paragraph 183) by the Chief Conservator of Forests of Bengal, who, in referring to the deterioration of forests through excessive grazing, observed "What appears to be light grazing in terms of head of cattle per acre is, in practice, concentrated near the village, in stream beds and grassy blocks, the last two being just where it does most harm" How could it be otherwise? The cattle leave the village in charge of an urchin or two soon after sunrise and return in the red evening light as the sun is dropping on to the horizon Two to four miles from the village is the utmost reached

The fuel or firewood (for it is chiefly the latter)

question is to some small degree analogous to that of the fodder one One factor governs both, so far as the agriculturists dwelling away from forest areas are concerned, and this is the cost of carriage of the materials Suggestions are made to the railway management upon this head As is well known, over large tracts of India the only fuel used is cowdung In the past the forest officer has often received ignorant censure for his inability to help to change this state of affairs whereby the manure of the fields is used to cook the food of the agriculturist Of course, the problem is one for the Agricultural Department and its experts to deal with, but the Commissioners, although recommending methods of dealing with the provision of grazing and fuel lands, frankly show up the true position when they write (in connexion with the Central Provinces) "A scheme to place at the disposal of the people cheap firewood from fuel depots at convenient centres in order to remove the need for burning cowdung has not met with encouraging results The continuance of this immemorial custom with firewood stacked almost at their door suggests that it is not lack of firewood which robs the soil of valuable manure"!

The Commissioners refer to the deplorable results of shifting cultivation (a matter which has already been treated upon elsewhere in NATURE), and they deal at some length with suggestions for improving the supply of fuel and grazing for villages when it is deficient throughout the country Their recommendations, put briefly, are that areas should be earmarked and maintained for this sole purpose They realise that their suggestion is not a new one, that in Bombay this method was already under trial, the areas so maintained being termed 'Minor Forests', whilst in Madras the so called poor scrub forests and grazing lands were being placed under 'panchayet' (that is, village) management

The Commissioners express no opinion as to the better form of management, that is, whether this type of forest area should remain under the Forest or Civil Department, but they advocate a study of the subject of establishing this type of 'minor forest' in order that each village will enjoy easy grazing and cheap fuel In these recommendations they will certainly have the hearty sympathy and the cordial support of the Forest Department But, in conclusion, the warning note with which this article commenced may be sounded once again Grazing and fuel areas, the primary object of which is to supply the requirements of a collection of individuals forming a village community who regard the area as their own property, require the most careful expert supervision and management if they are to continue to fulfil the objects of management Once relax the supervision and each individual will exert himself to get his share The Commissioners in dealing with Bengal appear to realise this They write "But it is not easy to convince the villager who needs fuel and the proprietor who needs cash, that temporary self denial will be more than repaid later on"!

The Theory of Atoms

The Greek Atomists and Epicurus a Study By Cyril Bailey Pp ix + 619 (Oxford Clarendon Press, London Oxford University Press, 1928) *24s* net

THE brilliant achievements of Hellenic genius in literature art, politics philosophy and mathematics have cast a reflected glory upon those Greek theories which may be considered as lying within the province of natural science This refulgence is apt to tire our mental retina, and we are perhaps too prone to assume an inherent luminosity where, in point of fact, none exists There is a tendency easily comprehensible but nevertheless entirely illogical to imagine that, since the Greeks excelled in philosophy, a similar excellence is to be found in their scientific attitude and theories It was, however, long ago pointed out by Whewell that "as soon as they had introduced into their philosophy any abstract and general conceptions, they proceeded to scrutinise these by the internal light of the mind alone, without any longer looking abroad into the world of sense They ought to have reformed and fixed their usual conceptions by observation they only analysed and expanded them by reflection" Without going so far as to agree with his conclusion that 'the whole mass of Greek philosophy therefore shrinks into an almost imperceptible compass when viewed with reference to the progress of physical knowledge," we may yet admit the general truth of his criticism, and we should take especial care not to read into the ancient theories conceptions which are essentially modern

There is, however, a more serious defect in Greek science than this irrepressible habit of disproportionate speculation It is that the Greek attitude towards Nature was to a large extent irrational, not merely in the riotous efflorescence of Neo Platonism but even in the greatest philosophers of the classical period Classical scholars may possibly regard this statement as heretical, but it would be easy to give chapter and verse to

confirm it Indeed, Prof Lynn Thorndike, in his excellent "History of Magic and Experimental Science," has already observed that Greek science was riddled with superstition, magic, astrology, and occultism of all kinds "we cannot explain away the vagaries of the *Timæus* as flights of poetic imagination or try to make out Aristotle a modern scientist by mutilating the text of the *History of Animals*" Hellas bequeathed to civilisation the priceless gift of logical deduction, but lacked the spirit of modern science "Everything," said Thales, 'is full of gods"

Lastly, Greek science made no effective use of experiment, even if it did not actually despise it The technical ability of Greek craftsmen is undeniable, and we are certain, therefore, that the philosophers could have found plenty of material for experiment if they had but realised its importance This realisation was, however, not vouchsafed to them, nor, in fact, did it permeate the body scientific until comparatively recently Even so late as the eighteenth century, we read, the professor of chemistry at the Jardin des Plantes never soiled his fingers with chemicals—he left that to an inferior personage, the demonstrator

Having said the worst of Greek science we can the more readily agree that its chief theory, that of atoms, is free from the gravest of the three defects enumerated above, for on its physical side it cannot in any legitimate sense be described as tainted with superstition The atomic theory, especially perhaps in the form given to it by Democritus, has undoubtedly a right to be regarded with reverence by men of science, for although the modern theory is related to that of the Greeks much as a man is related to one of his simian ancestors, the continuity is unbroken from Leucippus to Dalton Mr Cyril Bailey's fine study of atomism will consequently be of as great interest to men of science as to students of the humanities, and the former will particularly welcome the restrained way in which he makes his comparison between the ancient and modern theories "Ancient speculation," he frankly admits, "is a very different matter from modern research at its best it rested in the main on *a priori* reasoning, and though observation and even experiment may have given some knowledge of detail, they had little place in the development of the larger fundamental theories And not only do methods differ, but the fundamental conceptions of the atom in the ancient theory and modern chemistry are widely divergent" To this 'gesture' it would be churlish not to reply with an equally frank admission that Newton and Dalton ultimately owed their inspiration to Leucippus, Democritus and Epicurus, and that but for the speculations of ancient Greece the modern theory may never have seen the light It is, in truth, a pleasure to be able to follow Mr Bailey through the pages of his story without feeling that we are swerving from our allegiance to those two geniuses who established the atomic theory as we know it

Mr Bailey first describes the antecedents of atomism and then passes on to Leucippus, who, he says, regarded himself, and was generally considered in antiquity, as a mediator between the Eleatic Monism of the successors of Parmenides and the Pluralism of Empedocles and Anaxagoras The atomic theory, as conceived by its founder, Leucippus, was 'a reconciliation of those many antinomies which had sprung up in the course of earlier discussion, the One and the Many, change and permanence, division and continuity, the senses and thought" Democritus elaborated the theory into a more or less universal system Receiving it from Leucippus as a rather crude and tentative speculation, he left it in a highly developed and strengthened form "with him, Atomism as such reached its highest development in Greece" In the hands of Epicurus, to whom more than half the book is devoted, the atomic theory became even more complex, and although the physical hypotheses which it expounds are of extremely great interest, the scientist cannot bring himself to approve of such devices as the postulation of a 'swerve' in the path of the atoms, in order to escape from the determinism of Democritus It is of course in this and similar respects that the modern theory differs so much, not merely in form but also in spirit, from the great scheme so lucidly and beautifully described by Lucretius That free will has its explanation in the deviation of atoms from a rectilinear path is conceivable, but as a scientific hypothesis it is merely useless Dalton's theory is very much simpler than that of Epicurus, because it assumes less and attempts to explain less, yet in point of fact it has explained much more

It would be an impertinence for us to offer any opinion upon Mr Bailey's conclusions from the literary point of view, but from that of science we may thank him for an unusually clear exposition of the birth and early life of one of the greatest of scientific theories His book must be for many years the most authoritative on the subject, and, unlike many 'authorities,' it is a delight to read

E J Holmyard

Solutions and Heat Engines.

Gases and Liquids a Contribution to Molecular Physics By Dr J S Haldane Pp xv+334 (Edinburgh and London Oliver and Boyd, 1928) 18s net

THIS volume originated in the attempts of the author to apply current conceptions of osmotic pressure to physiological processes He appears to have been led on from one subject of physics to another, and to have found difficulties at every step The source of these difficulties is apparently to be sought in a tendency to take the elementary statements in text-books as representing the best knowledge on a subject, whereas in all such elementary instruction it is usually necessary to strip the subject bare of all complications It may perhaps quite rightly be urged that this simplification is carried to excess, and that it does often mislead a student For example, van 't Hoff, in his desire to show that for dilute solutions there was a close analogy between the laws of osmotic pressure and those of gases, concentrated attention on such cases and bent all his energies to demonstrate this analogy in all its details and the consequences of it By doing this he was able to show that the resemblance between the two phenomena was so complete, not only qualitatively but even quantitatively, that there could be no doubt that osmotic pressure and gas pressure were due to the same cause But at the same time the consideration of more complicated cases was left on one side, and such cases were often forgotten

Of course, when concentrated solutions are considered, there are difficulties, just as there are for gases , but this does not take away the importance of the truth that the gas theory of osmotic pressure is the only theory from which it has been possible to calculate the pressure Moreover, any other theory which may be put forward as an alternative explanation must not only explain the pressure but must at the same time *explain away* the effects that must arise from the molecular bombardment However, Dr Haldane will have none of this The theory to him " is inherently unintelligible " He resuscitates the old idea that the pressure goes the wrong way He will see that his objection is invalid if he will consider that the effect of the bombardment is to tend to expand the volume of the solution, and that therefore if water can flow in through a membrane it will do so

Similarly, Dr Haldane is 'up against' van der Waals : " van der Waals' interpretation of his equation is, however, not only very improbable, but would make it impossible to extend the dynamical theory to the phenomena observed in liquids " " The theory of van der Waals treated gases as if they were already liquids, and it could thus give no account whatever of condensation to the liquid form, or of a critical temperature "

Statements such as these are not of rare occurrence, but may be taken as characterising Dr Haldane's attitude towards his subject It is when he comes to consider Carnot's principles and the ideal engine by which Carnot demonstrated them that his antagonism to physical conceptions is most conspicuous and startling He makes much of the fact that it is not possible to make such an ideal engine The valid conclusion to draw is that no real engine will have an efficiency so great as that demanded by Carnot (and by those who transformed his views to suit the law of conservation which was unknown to Carnot) Dr Haldane claims to show " that existing kinds of heat engine can, as a matter of fact, work far more efficiently between two temperatures than a Carnot engine " We fail to follow how he comes to this conclusion, especially as in the engines described by him the formula which he himself gives indicates only *half* the Carnot value for a given pair of temperatures There is some confusion here which requires further elucidation But assuming the validity of Dr Haldane's claim, we would commend it to the attention of central heating engineers, for there should be commercial profit in it

The Geology of Southern Africa.

Geologie der Erde Herausgegeben von Prof Dr Erich Krenkel *Geologie Afrikas* Von Prof Dr Erich Krenkel Zweiter Teil Pp xii+463-1000 + Tafeln 22 37 (Berlin Gebrüder Borntraeger, 1928) 45 gold marks

SOUTH AFRICA is of special geological interest from its simplicity and symmetry of structure, its instructive series of pre Palæozoic rocks, its Karroo formation, with a succession of terrestrial deposits ranging from the Carboniferous to the Jurassic, and with important fossils, glacial beds, and vast lava sheets, the clues given by its Cretaceous beds as to the arrangement of ocean and continent in the South Atlantic region during the Upper Mesozoic, and its unique mineral deposits of diamonds, gold, platinum, and chromium, and its vast stores of coal The second volume of Prof Krenkel's " Geologie Afrikas " has been appropriately devoted to South Africa, which, owing to its unity, is well adapted to monographic

description The area described lies south of the Lower Zambezi, and farther west is bounded in general by the southern watershed of the Congo, the book therefore deals with Northern and Southern Rhodesia, all the Union of South Africa, and Mozambique, of which the treatment is proportionately briefer than the rest

The country consists of a high interior plateau bounded by a belt of lowland which contains many marine deposits—Devonian and Carboniferous in the Cape, and Cretaceous and Kainozoic in Natal, Mozambique, and along the western coast Marine rocks have often been reported on the plateau, and some of pre-Palæozoic age are accepted by Prof Krenkel on lithological evidence which is perhaps inconclusive, the only strong case is for some beds containing fragments identified as *Eurydesma* near Keetmanshoop, which were described as marine by Schroeder in 1908; in view of the significance of this occurrence, and the fact that reports of marine fossils from other localities, as from the Otavi Dolomite, have not been confirmed, a full account of the fossils from this bed would be useful The boundary between this coastal belt and the plateau has been generally known as the Great Escarpment, and Prof Krenkel in his interesting chapter on South African physiography has renamed it the Rogerstufe, after the head of the Geological Survey of South Africa

This volume has the advantage of following Dr du Toit's "Geology of South Africa," 1926, but it shows full evidence of independent preparation The two works are on somewhat different lines, which make them usefully complementary Instead of the abundant photographic plates which illustrate du Toit's volume, the chief illustrations provided by Prof Krenkel are a valuable series of excellent geological sketch maps and sections The opinions of the two authors are most in conflict over the bearing of South Africa and South America on Wegener's view that the Atlantic was formed by the westward drift of America Dr du Toit is a strong supporter of that theory Prof Krenkel, on the other hand, declares (p 613) that the mountain systems of the two areas differ in form, in the nature of their folding, their tectonic divisions, age, and geographical arrangement, and holds that owing to these differences the composition of these mountains of similar material is of no weight as evidence of their original connexion.

Prof Krenkel agrees with Dr du Toit and differs from the late Prof Schwarz and others as to the age of the Waterberg System, which he places in the Palæozoic, he refers to the presence of some impressions that have been regarded as crinoid stems, but the evidence for them should be quite distinct to be admissible in view of the other indications that these beds are of terrestrial origin Prof Krenkel's account is especially valuable in dealing with South-West Africa, for which Kaiser's great monograph was not available to Dr du Toit

The chapter on the economic geology is brief in proportion to the rest, the description of the mineral deposits includes the platinum lodes which are the latest addition to South African mineral wealth, and promise a welcome source of supply of that sparse and necessary metal

The bulk of the volume is occupied by detailed descriptions of South African geology, which are full and clear and accompanied by well-selected bibliographies The work contains less original matter than the first volume, which included areas which Prof Krenkel had investigated personally, but it will form an indispensable work of reference to those interested in African geology

Our Bookshelf

The Development of the Human Eye By Ida C Mann (Published for *The British Journal of Ophthalmology*) Pp x+306 (Cambridge At the University Press, 1928) 36s net

As Sir John Parsons has made clear in his foreword, this is no ordinary book or compilation, but a record of original observation on a subject of great scientific interest and practical importance For several years, at meetings of the anatomical and various ophthalmological societies, Dr Ida Mann has been giving demonstrations on the development of one or another feature in the human eye, which attracted particular attention by reason of the fullness of the evidence submitted and the lucidity of her exposition of the facts and their meaning

The admirable treatise Dr Mann has written is based upon Prof Ernest Fraser's collection of human embryos Her treatise provides the most complete account we have of the histogenesis of the human retina, lens, vitreous and their investing membranes, and material for the correct solution of scores of doubtful issues, which within the compass of a mere review it is not possible to enumerate Particular mention must be made of the 241 illustrations, the great majority of which are the author's own draughtmanship, remarkable alike for their clearness and adequacy, as well as for their artistic charm The Cambridge University Press has done full justice to Miss Mann's drawings, which have been reproduced on a generous scale The book forms a valuable addition to our knowledge in such an attractive form that it is certain to become a standard work for the student to read

and the practitioner to consult. It has a useful bibliography

The directors of the *British Journal of Ophthalmology* are to be congratulated on promoting the publication of a treatise which not only reflects the greatest credit on the author and the Medical School at St Mary's Hospital, but also adds distinction to British ophthalmology

Dizionario di sinonimi e composti chimici con relative formole e pesi molecolari e le terminologie chimica, farmaceutica, alchimistica Per Prof Calisto Craveri Pp. vi + 316 (Milano Ulrico Hoepli, 1928) 35 lire

This book is divided into two parts, the first and larger of which is composed of a list, in alphabetical order, of upwards of 30,000 terms, consisting mostly of the Italian names of chemical compounds, together with their synonyms Included also are short accounts of the origin and meaning of such words as acetification, acid, balsam, compound radicals, cupellation, extractives, liquation, refining, saponification, spirit, substitution, vitriol, etc Some of the commoner alchemistic and pharmaceutical terms are also explained The second part comprises two lists of the names, formulæ, and molecular weights, (1) of those inorganic compounds, and (2) of those organic compounds, for which no synonyms exist

A great amount of labour must have been expended in the compilation of this volume, but the results cannot be described as other than highly unsatisfactory The first part may be of some interest to the student of chemical history, but throughout the book frequent errors occur in the formulæ and in the molecular weights Even the molecular weights of such simple substances as sulphurous acid, fuming sulphuric acid, and aluminium phosphate are incorrectly given, and that of alumina is written 012 20 , aluminium carbonate and aluminium fluoride are allotted wrong formulæ The symbol of boron is given as both Bo and B, and that of fluorine as both Fl and F Moreover, in many instances, for example on pp 110 111, the items are arranged out of order

The book would need very thorough revision before it could be recommended

British Museum (Natural History) Catalogue of the Pontian Bovidæ of Europe in the Department of Geology By Dr Guy Ellcock Pilgrim and Arthur Tindell Hopwood Pp xii + 106 + 9 plates (London British Museum (Natural History), 1928) n p

The authorities of the British Museum of Natural History are to be congratulated on the form in which they are now issuing the catalogues of their palæontological collections These now come out singly, each one dealing with a particular group or subject, in a bound volume very convenient both for handling and reference

The latest to appear is an account by Dr Pilgrim and Mr A. T Hopwood of the Pontian Bovidæ of Europe as far as the subfamilies Gazellinæ, Pseudotraginæ, Bubalidinæ, Hippotraginæ, Cervicaprinæ, and Tragelaphinæ. In the preface, Dr Bather, lately Keeper of the Geological Collections, utters a hope that this memoir is but the first of a series to deal with the rich collections of Pontian mammals in the Museum—a hope that will be shared by all workers in this field While the catalogue deals chiefly with the actual specimens in the Museum, due reference is made to types in foreign collections, so that the usefulness of the publication is enhanced The bulk of the work is of course a descriptive account of the species, with their diagnostic characters and a list of the material, thus fulfilling the primary duty of a catalogue, but there is, in addition, a short introduction which gives information of the classification followed, and hints at some of the difficulties which are involved in the handling of incomplete material There is a full and useful list of works consulted, and the illustrations are adequate

No price is stated on this volume, as it is in some It would be well to give this information as a uniform custom

Dacia an Outline of the Early Civilisations of the Carpatho-Danubian Countries By Vasile Pârvan Pp xi + 216 + 16 plates (Cambridge At the University Press, 1928) 7s 6d net

This little volume has been published as a permanent memorial of the late Prof Pârvan's visit to Cambridge in 1926, when he delivered a short course of lectures on the civilisations of the Carpathian and Danubian countries Himself a native of Moldavia, where he was born in 1882, he was imbued with " a strange instinct for its Latinity " Although he showed at an early age a high attainment in pure scholarship, he devoted himself with untiring energy to the prosecution of excavations in the little-explored regions of Rumania Detailed accounts of the results achieved by himself and the school of young men whom he gathered around him were published in a periodical, *Dacia*, which he founded himself, but his most comprehensive account of Carpatho Danubian archæology was published under the title " Getica " Of this work the present volume is in effect a summary, covering the period from the middle of the Bronze Age down to and including the intrusion of the Romans For those who are unable to consult the larger work, which unfortunately has not been translated, this little book, dealing with an at present obscure subject, will be invaluable

The Glands of Destiny (A Study of the Personality) By Dr Ivo Geikie Cobb Pp vii + 295 (London William Heinemann (Medical Books), Ltd , 1927) 7s 6d net

The subject of this volume is of sufficiently intimate a character to command a wide circle of interest, especially as general as well as special terminology is used and a glossary is provided The general reader will find much useful information and also much to interest him of a slightly speculative nature A good case is made out for placing the factors which combine to form the ensemble connoted by the term ' personality ' on a more definite physiological basis rather than on a vague psychological elaboration.

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications*]

What Happens during an Electron Jump?

THE Bohr theory showed its inadequacy most when the above question was asked After describing the motion of an electron with minutest detail in all of its many orbits, a deafening silence answered him who inquired how the electron got from one orbit to another The most one could say was that it suddenly disappeared, and simultaneously reappeared in an outer orbit, or vice versa

Now, I believe the Schrödinger theory has implicitly tied up with it the answer to this question Pauli's interpretation (cf Jordan, *Z Physik*, **40**, 811) that the expression

$$|\psi_{(q)}|^2 dq$$

represents the probability that the electron has a co ordinate lying between the values q and $q+dq$ has led to the idea, permeating the quantum mechanics, that the electron, in tracing out its path, can go almost anywhere, but that the positions where it is most often found trace out the Bohr orbits In other words, the electron orbit represents a cloud in space, the centre of gravity of which is the locus of a Bohr orbit The Schrödinger condition, that ψ be finite throughout all of space, is then intelligible as meaning that the probability of the electron being at any position in space must be finite If this is true, then what does the intensity rule for a spectral line mean in terms of this interpretation?

It has been shown—can we say experimentally?—that the intensity of a spectral line or the probability of a spontaneous electron jump, is proportional to the square of the matrix element,

$$q_{nm} = \frac{\int q\rho(x)\psi_n(x)\psi_m(x)dx}{\sqrt{\int\rho(x)[\psi_n(x)]^2dx \int\rho(x)[\psi_m(x)]^2dx}}$$

(Schrödinger, *Ann Physik*, **80**, 465, Born and Jordan, *Z Physik*, **34**, 886) Let us disregard the denominator of this expression (introduced for normalisation purposes) and focus our attention on the product of ψ_n by ψ_m

If an electron in state n happens to occupy a position x_1 at a certain time and can occupy that position x_1 with more or less probability while belonging to energy state m, then there is a probability of absorption of light, provided the photon comes along at that particular instant If the same electron belonging to energy 'orbit' n occupies a different position, x_2, at, say, a different time and it could occupy that position x_2 just as well (more or less) while belonging to energy state m, then we have a greater likelihood of its absorbing a photon For if the photon did not come along while the electron was at x_1, it might get there while the electron was at x_2 So the total probability of the electron undergoing a 'jump' will be the summation of the probabilities of the ability of the electron to occupy identical positions in the two states, over all the different positions it might occupy

This leads us to the conclusion that in an electron 'jump,' *the electron does not jump* It does not change its position It does not disappear suddenly and reappear simultaneously in another place At most, it undergoes a change in momentum and obeys a new force law, in much the same manner that a vibrating molecule behaves after absorbing light According to the Franckian explanation (*Trans Faraday Soc*, **21**, 536) the nuclei vibrating about an equilibrium position r''_e suddenly discover, immediately following the electronic excitation, that their equilibrium position is now no longer r''_e but a different one (that is, r'_e) and so they have to vibrate according to the new law of force In the case of an electron 'jump,' the electron suddenly experiences a momentum change by a Compton effect, and its natural motion thereafter is of a different type from what it was before the absorption of the photon because it has gained more kinetic energy

I am well aware that I shall be criticised for discussing a phenomenon which, so far, is unmeasurable But it seems to me this new interpretation of an electron transition removes the necessity for the tacit neglect of this most interesting question, it hushes the accusation of inconsistency in physical theory, in this one particular at least, it aids us in a more complete visualisation of atomic processes; and, at the same time, it does not violate Heisenberg's uncertainty principle

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The Boundary of the Solar Chromosphere

IN analysing photographs of the flash spectrum it is customary to measure the lengths of the chromospheric arcs on the negative, and to deduce therefrom the heights to which various elements rise in the chromosphere The H and K lines of calcium are always found to rise the highest, and their extent fixes the boundary between the chromosphere and the corona One would very much like to know photometrically whether the intensity of H and K light is really falling off rapidly at this apparent boundary, or whether it fades out slowly and extends appreciably beyond Since 1897 the view seems to have prevailed that it does not In that year Young wrote "The photograph also seems to make it certain that hydrogen, helium, and calcium, though brilliantly conspicuous upon the plate in the images of the prominences, are *entirely absent from the corona*, a result agreeing with that deduced from similar photographs made in 1893, but only recently published It is quite clear that the earlier observations (referred to on pages 261 and 262 of 'The Sun') were misleading from the fact that the apparatus did not sufficiently guard against the effects of illumination of the air by light from the prominences' (*Astrophysical Journal*, **6**, 155) By illumination of the air is meant scattering of light in the earth's atmosphere

It is well known that the height to which spectral lines are observed to rise in photographs of the flash spectrum is often misleading, since the height depends on the intensity of the line Of two lines arising from transitions from the same energy level of the same atom, the less intense may rise to only a small fraction of the height to which the stronger line is found to extend The question arises Is the apparent extent of the H and K lines any more trustworthy? This problem has become important for the more detailed application of Milne's theory of support by radiation pressure

The recent extension of Milne's theory by Taylor (*Monthly Notices R A S*, **87**, 616, 1927) throws doubt on the reality of the apparent boundary of the calcium chromosphere, which all observations agree in placing at not more than 14,000 kilometres above the limb. On the contrary, the intensity of the H and K lines is now supposed to extend far beyond this limit, fading

out very slowly Milne has accepted with approval this extension of his theory "The spectral observations made by Col Stratton and Mr. Davidson at the eclipse of 1926 (Sumatra) have been analysed by Mr P A Taylor He first extended the theory so as to allow for the curvature of the sun, and then compared the observed outward decrease in intensity of the flash spectrum with the calculated decrease It appeared that all but about one ten thousandth of the weight of the calcium chromosphere was supported by radiation pressure" (NATURE, 121, 944, 1928) The same point of view seems to have been taken by McCrea in his further extension of the theory (*Monthly Notices R A S*, 88, 737, 1928) So it seems worth while to consider whether the sharpness of the apparent boundary can be illusory

Visual measurements as well as photographic are possible for the height of the $H\alpha$ line Some observations in full daylight were made by Fox (*Astrophys J*, 57, 234, 1923), under unfavourable weather conditions he found a height of 7500 km, which agrees roughly with the height 8500 km found from photographs of flash spectra Observations of the H and K lines by photographic methods are more difficult, but a similar rough agreement is found

Now, Kunz and Stebbins found that the brightness of the sky near the sun was 5000 times less intense during a total eclipse than in full daylight (actually 5300 times at the 1918 eclipse and 5500 at the 1925 eclipse *Astrophys J*, 62, 125, 1925), and it seems incredible that, when the chromosphere is viewed in daylight against a brighter background, roughly the same apparent limit should be found as in a total eclipse, unless there really is a rapid decrease in intensity at this boundary

In addition to the photographs of the 1926 eclipse (*Mem R A S*, 64, 105, 1927), on which Taylor based his conclusions, photographs were also taken in Sumatra simultaneously by Miller and Marriott (*Astr Soc Pacific*, 40, 98, 1928) They state that on their photographs "strong H and K and hydrogen emission lines due to the scattering of light in the earth's atmosphere are superimposed upon the corona spectrum and extend into the lunar disc, but no Fraunhofer lines are seen on the disc, and only a slight suspicion of continuous spectrum" In the photographs of Davidson and Stratton the slit was tangential to the disc, instead of radial, so that the extension on to the disc was not observed and does not seem to have been taken into account It is to be hoped that in the future it will be possible to make the difficult correction for scattering in the earth's atmosphere In the meantime it would seem best to retain Young's conclusion quoted above, and suppose that the apparent boundary is real, with a rapid falling off in intensity To obtain this result from Taylor's theory it may be only necessary to assume that about one thousandth of the weight of the chromosphere is supported by gravity, instead of one ten thousandth

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The Gamma Rays of Radium.

EXPERIMENTS which have been carried out here during the past few years lead to the following conclusions

(1) The γ-rays filtered through 1 6 cm of lead, and issuing from a hole in a lead block, have an average wave-length not greater than 0 0081 A or a value of $\alpha = h\nu/mc^2$ not less than 3 For these γ-rays, using the usual nomenclature, $\sigma_a = \sigma_s$ approximately and not $1/2\sigma_s$, as is usually supposed

The distribution of the scattered radiation is approximately that given by the Klein–Nishina formula (NATURE, vol 122, p 398, 1928) namely,

$$I_\theta = I\frac{e^4}{2m^2c^4r^2}\left\{\frac{1+\cos^2\theta}{(1+\alpha-\alpha\cos\theta)^3}+\frac{\alpha^2(1-\cos\theta)^2}{(1+\alpha-\alpha\cos\theta)^4}\right\},$$

the symbols having their usual significance

From this formula we deduce that $\sigma_a = \sigma_s$ approximately, and also values of α which are within ten per cent of the values found by Gray and Cave (*Trans Roy Soc Can*, vol 31, § 3, p 7, 1927) This means that we may use their theory with some confidence in the interpretation of cosmic ray experiments

(2) The Dirac theory of scattering is not correct. In the γ-ray region it leads to values of α which are much too small (compare Gray and Cave, loc cit), the corresponding recoil electrons having only one-third the required penetrating power

(3) The ionisation produced, in a closed vessel, by rays of high frequency having a negligible photo-electric absorption coefficient τ, is approximately independent of the material of which the vessel is made This assumes that the rays do not react with atomic nuclei

(4) τ for hard γ rays varies with a power of the wave-length much smaller than the 2 5[th]

(5) The ionisation produced in a paper electroscope by γ-rays is increased by surrounding the electroscope completely by lead or brass two millimetres thick.

(6) The apparent absorption of an initially parallel beam of homogeneous γ rays continually increases, presumably until a maximum is reached

Making use of the above conclusions, an examination has been made of the results of cosmic ray experiments, and a further communication will be made later

I feel that the method developed here four years ago for the determination of γ ray wave lengths has not been understood, doubtless because sufficient details have not been given An outline of the method follows

It is necessary to know

(1) The penetrating power of the recoil electrons.
(2) The penetrating power of homogeneous β rays
(3) The distribution of scattered radiation, *i e* the variation of I_θ with θ

It is assumed that the ionisation in a vessel of which the walls are of a substance of low atomic weight is produced by recoil electrons of energy E given by the equation

$$E = h\nu\frac{\alpha - \alpha\cos\theta}{1+\alpha-\alpha\cos\theta},$$

the radiation scattered at angle θ having a frequency ν_θ given by the equation $\nu_\theta = \nu/(1+\alpha-\alpha\cos\theta)$ If we write $I_\theta = F(\cos\theta)$, the number of quanta scattered between angles θ and $\theta + d\theta$ will be proportional to $F(\cos\theta)\ (1+\alpha-\alpha\cos\theta)\sin\theta\ d\theta$, and the number of electrons $N_E dE$ with energy between E and $E + dE$ to $F(\cos\theta)\ (1+\alpha-\alpha\cos\theta)^2\ dE$, since $\alpha\sin\theta\ d\theta = (1+\alpha-\alpha\cos\theta)^2\ dE$

Relative values of N_E can then be obtained by putting $\cos\theta = 1$, 0 9, 0 8, etc , in the above expression for $N_E dE$, the corresponding values of E being found from the equation for E This enables one to plot N_E against E One must then allow for the fact that the smaller E is, the greater is the ionisation produced by a single electron Making the necessary corrections, what may be termed I_E is obtained, $I_E dE$ being the ionisation produced by electrons with energy between E and $E + dE$

I_E is then plotted against E, and a value of α is taken which will give the electrons as a whole the penetrating power found by experiment As $\alpha = h/mc\lambda$ we can then find the wave length λ

It will be seen that from experiment (3), $F(\cos\theta)$

can be read directly from the curve obtained by plotting $F(\cos\theta)$ against θ. The problem, however, is simplified if we can find a formula, such as that of Klein and Nishina, which fits experimental results. An application of the method will be given later.

I have often found that work which it pleases me to think was of a pioneer character has been overlooked by other writers. I would like to emphasise the fact that most of the results given above follow directly from views developed here many years ago.

J. A. GRAY.

Queen's University,
Kingston, Ontario, Dec. 26.

Some Aspects of Hæmolysis

MANY years ago, Sachs (*Biochem. Zeit.*, **12**, 278; 1908) showed that normal serum which ordinarily inhibits the hæmolysis of red blood corpuscles by soaps when present before the addition of the hæmolyte, accelerates this hæmolysis if it is added after the addition of the soap to the corpuscles. Later, Ponder (*Proc. Roy. Soc.*, B, **95**, 403; 1923) studied this phenomenon with taurocholate as the hæmolyte. In a recent paper we found (*Jour. Ind. Chem. Soc.*, **5**, 261; 1928) that under the conditions of the experiment used by us, no acceleration of taurocholate hæmolysis could be observed irrespective of the

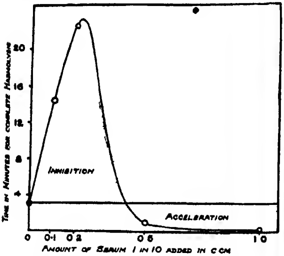

FIG. 1.—Effect of normal serum on a mixture of taurocholate and erythrocyte in isotonic saline.

manner of the addition of the serum, and Ponder suggested to us, in a private communication, that this was due to the particular conditions of our experiment, and that the acceleration could be observed under different conditions.

We have now made a detailed study of the inhibition and acceleration of hæmolysis in presence of normal serum, and have observed that both acceleration and retardation of hæmolysis can be obtained easily in taurocholate and oleate hæmolysis by simply varying certain concentrations of the reacting substances. Since no one has yet published any data of similar nature, we desire to put on record the conclusions we have reached. In the accompanying curve (Fig. 1) we have plotted one set of results with varying amounts of serum. The quantity of the corpuscle, the total volume and the quantity of the sodium taurocholate were kept constant, but the amount of serum which was added to the cells half a minute after the addition of the taurocholate was varied. The abscissa represents the amount of serum, and the ordinate represents the time required for complete hæmolysis under otherwise identical conditions. A glance at the curve will show that we can get either an inhibition or an acceleration of hæmolysis when serum is added to a mixture of hæmolyte and corpuscle depending on the quantity of the serum.

We have also investigated the effect of the concentration of the corpuscles, of the amount of the hæmolyte added, and also the effect of the time-interval after which the serum is added, on the observed acceleration; and have found that all these factors are more or less important in showing this particular phenomenon. We have also found that normal serum is not the only substance which shows this acceleration phenomenon with oleate and taurocholate; a very dilute solution of alkali such as caustic soda can also show this behaviour with oleate and taurocholate, and we have been able to obtain almost similar curves with taurocholate and caustic soda. We consider, therefore, that in order to produce this acceleration phenomenon, it is not necessary to suppose any peculiar actions of the added serum proteins; because traces of pure alkali have been found to be equally effective, and the action of the normal serum may consist, at least in part, in changing the hydrogen ion concentration of the solution. We may add that this acceleration of hæmolysis by normal serum has been observed with taurocholate and oleate as the hæmolyte, but we have failed to get any acceleration with saponin.

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Mechanism of the Swelling of Gels

THE problem of the swelling of gels has been the subject of a great deal of research, and still there does not appear to be any clear agreement between the views of different workers regarding the mechanism of the process. To take the case of gelatin, swelling is usually attributed to an osmotic action due to the presence of a soluble form of gelatin or its salt inside the molecular network of the gel. Recent work by myself (*Proc. Roy. Soc.*, A, **122**, p. 76; 1929) on the scattering of light in agar and gelatin sols and gels seems to indicate that these systems contain, to some extent at least, colloidal micelles which act as units. None of the existing theories says anything about the changes in these micelles during swelling. The object of the present note is to indicate the usefulness of light-scattering measurements in revealing these changes.

If a piece of gelatin be immersed in water it becomes opalescent as a result of swelling. This fact seems to have escaped the notice of previous investigators. The opalescence can be clearly noted when the swollen piece is viewed against a dark background. To find out the exact significance of this observation, it is necessary to determine the changes in light-scattering during swelling. The gel used in this investigation was obtained by drying a 2 per cent gel of $pH = 3$ in a suitable bottle. The results are given in the following table:

Wt. of gel	Intensity of Scattered Light ($C_6H_6 = 1$).
3 gm.	67·7
5·64 „	73·3
7·86 „	67·6
12·54 „	48·9
16·40 „	42·9

It can be seen from the above data that the intensity of the scattered light increases at first and then diminishes as swelling proceeds.

These observations appear to me to provide a basis for the following picture of the mechanism of swelling: Swelling occurs as a result of imbibition of the solvent by the gel. We have to distinguish between two kinds of imbibition—one, in which the solvent is actually taken up inside the structure of the gel micelles This part is held firmly by the molecules constituting the micelle owing to forces which are probably chemical in nature, and causes an increase in the volume of the micelles, and hence an increase in the light scattering capacity of the gel This process stops when a certain limit is reached, depending upon the cohesion between the molecules constituting the micelles Secondly, the solvent which is still further taken into the gel remains in the intermicellary space, thus causing a dilution of the gel, and hence a diminution in its light-scattering capacity This view is in complete harmony with the results obtained, and receives further support from the following observation:

A four per cent gelatin gel at the isoelectric point is very turbid When this is dried in a desiccator, at first there is no change in the turbidity of the gel, but after a few weeks it commences to clear up from the top As the dehydration proceeds, the whole gel becomes quite transparent by the time it shrinks to about two thirds its original volume This observation seems to be quite significant in that it shows definitely that the removal of the liquid in the earlier stages is not accompanied by any shrinkage of the micelles, while, later on, they do shrink, causing a very marked diminution in the light scattering

Further work on the changes in the scattering of light during the swelling of gelatin and other gels is in progress

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Resistance of Wheat Varieties to Bunt (*Tilletia caries*)

A VARIETY of wheat, Sherman (*T vulgare* Vill), stated to be resistant to bunt, has been grown at Cambridge for the past five seasons It has been tested for resistance or susceptibility to the fungus *Tilletia caries* (DC) Tul (= *T tritici*) (Bjerk) (Wint) It was previously tested in 1923 at Moro Ore U S A, by the Cereal Investigation Board The percentage of bunt then obtained was 1 1 In 1924–1926 it was very heavily contaminated by me at the rate of one part of crushed bunt balls to 25 parts of wheat At the 1925 harvest, the percentage of bunt present was 1 01, at the 1926 harvest 1 6 It thus seemed evident that Sherman was very highly resistant to the disease

In 1926 the wheat was re-sown and one half of the seed was contaminated with Little Joss bunt and the other half with its own bunt, that is, Sherman bunt At harvest in 1927 the percentage of bunt respectively in the two plots was as follows Sherman with Little Joss bunt, 8 1 bunted ears; Sherman with Sherman bunt, 85 7 bunted ears It is perhaps necessary to explain that the figure 8 1 is very high, having regard to the fact that the variety was contaminated with Little Joss bunt The reason is probably that in hand threshing the Sherman wheat it was slightly contaminated with its own bunt Very often in apparently clean ears there is a bunted grain, especially in certain varieties In threshing, the ears of clean Sherman wheat selected for propagation may have been accidentally contaminated in this way The difference in the two cases, however, is so extremely great that the main conclusion is not obscured.

In all cases the percentage of bunt was obtained by taking a count of a thousand ears, and the plots were sown the same day and under identical soil conditions.

Other wheat varieties, notably Ridit, Turkey, Hussar, and Berkeley Rock, known to be resistant to *T caries*, have since been broken down by the same method of treatment In one case Berkeley Rock was contaminated in 1927 with Little Joss bunt, and at harvest it produced 1 6 per cent of bunted ears only, contaminated with its own bunt it produced 91 1 per cent of bunted ears In all cases the wheat was contaminated with spores until it was literally black, a spore load known to be sufficient to produce maximum infection

In the same way that the plant breeder may select a unit from a population of a variety for resistance to a certain pathogen, so the destructive mycologist may select a pathogen from an analogous population to which a given host is susceptible

Since the main results and conclusions of this investigation will not be published for some time, it is believed that this preliminary note upon the subject will be of value to workers engaged in the selection or hybridisation of wheat varieties for resistance to bunt

W A R DILLON WESTON

School of Agriculture,
Cambridge

Blue Rock Salt

I WAS glad to learn from his interesting letter in NATURE of Jan 26, p 130, that Mr F C Guthrie has verified our observations on the thermoluminescence of natural blue rock salt, which were published in the *Sitzungsberichte der Akademie der Wissenschaften in Wien* (II *a*), 132, 261, 1923, in collaboration with Miss M Belar Since then many samples of rock salt from various localities have passed through our hands, with the result that blue or violet pieces invariably show thermoluminescence, whilst colourless ones in general do not, only some very impure and opaque white pieces being an exception It is scarcely to be doubted that the increased energy-content of the blue rock salt was acquired through absorption of some radiation, most likely of radioactive origin

I would like to direct the attention of those interested in the subject to my two reports in the *Zeit für Physik*, **20**, 196 (1923), and **41**, 833 (1927), on the work done in this Institute on the artificial and natural coloration of salts, and to my more recent communications to the Vienna Academy (*Wiener Ber* (II *a*), 136, 43, 435, 679, 685; 1927 **137**, 409, 1928 *Wiener Anzeiger*, **274**, 1928, **8**, 1929) on this subject

The results given in the last mentioned note seem of more general physical, mineralogical, and technological interest, bearing, as they do, on the much discussed question of recrystallisation, so I take the opportunity of stating the principal ones here explicitly in pressed rock salt, which, as I have shown, turns rapidly black under radium radiation, and blue on subsequent exposure to daylight, there appear under prolonged radium treatment lighter yellow regions which expand from day to day Cleavage in such regions shows the pressed salt to be perfectly recrystallised There is definite evidence that the radiation not only offers a convenient way of showing the progress of recrystallisation, but also actually promotes it These observations may give a clue to the explanation of some curious morphological details in natural blue rock salt, on which subject more will be said in a future communication to the Vienna Academy

KARL PRZIBRAM

Institut für Radiumforschung,
Vienna

The Absorption Spectrum of Vitamin D

WITH the assistance of Mr R G C Jenkins and Miss C Fischmann, we have now fully confirmed the theory suggested previously that the ultra-violet irradiation of ergosterol produces three substances in succession (Webster and Bourdillon, *Biochem J*, **22**, 1223; 1928 *J Soc Chem Ind*, **47**, 1059, 1928) Of these, the first shows intense absorption for wave-lengths between 2500 A and 2900 A, and great anti-rachitic power The second shows intense absorption at 2400 A, and no antirachitic power The final product (or products) has little or no appreciable absorption and no antirachitic power We are now convinced that the first substance is vitamin D, for the following reasons

(1) In a prolonged series of experiments we have studied solutions formed by the irradiation of ergosterol, under various conditions and in various solvents, and after removing the unchanged ergosterol (by treatment with digitonin) have measured the specific absorption between 2700 A and 2900 A and the antirachitic activity of these solutions We have found satisfactory quantitative agreement between the two properties over a wide range, intense absorption being accompanied by great antirachitic activity, and solutions with smaller absorption showing correspondingly weaker activity

(2) By further radiation of such solutions through a filter of alcoholic cobalt chloride (thus excluding radiation of wave length less than 2600 A), we have obtained solutions showing very slight absorption at 2700 2900 A, but intense absorption at 2400 A These solutions showed no antirachitic activity when tested in doses which would have revealed one five-hundredth of the original activity

T A WEBSTER
R B BOURDILLON
National Institute for Medical Research,
Hampstead, N W 3,
Feb 5

Spectrum of Doubly Ionised Bromine

FOLLOWING the method of locating spectra by the horizontal comparison method described by Dr Saha and Mr Majumdar (*Indian Journal of Physics*, vol 3, Part I, 1928), I have been able to classify the spectrum lines of doubly ionised bromine We take the series of elements As^{++}, Br^{++}, Y^{++}, the spectrum lines due to the transitions $[xN_2(0_1 \leftarrow 0_2)$, $x = 0$ for As^{++} and 6 for $Y^{++}]$ have been obtained for As^{++} by Lang, and Y^{++} by Millikan and Bowen From these it is quite easy to extrapolate the corresponding lines of Br^{++} They were located at $\nu = 28000$ for the ${}^4PD$ group, and at 31000 for ${}^4PP$ due to the transition $[2N_2(0_1 \leftarrow 0_2)]$ of Br^{++}

A strong group of lines in this region was obtained by Bloch and assigned to Br^{++} I had not much difficulty in finding out the whole term system Some of the lines are given, ${}^4P_2D_3$, 28063, ${}^4P_2\bar{F}_3$, 31497 and ${}^4P_2S_2$, 33096, ${}^2P_2{}^2P_2$, 29995 In addition, the lines due to $2N_2(0_2 \leftarrow 0_3)$ transition have also been obtained.

SURESH CHANDRA DEB
Physical Laboratory,
Allahabad, Dec 22

Spectrum of Doubly Ionised Krypton.

THE spectrum of doubly ionised krypton has been under examination by me for some time past It seems evident that the strong group of lines about the wave-length 3250 belong to Kr^{++} A preliminary attempt has revealed a number of regularities I give below three sets of terms *A*, *B*, and *C*, which have so far been obtained The strongest lines are obtained from the terms $A \rightarrow B$, and probably represent the transition $3N_2 0_1 \rightarrow 3N_2 0_2$ The other transition, $3N_2 0_2 \rightarrow 3N_2 0_3$, etc, may appear as $B \rightarrow C$

A

0	716 6	2910 8	3346 2
3861 4	4968 9	4998 9	6122 8
8100 9			

B

30800 0	33360 2	33770 1	35187 6
35553 8	35857 6	35982 1	38407 6
38825 3	39795 6	40385 1	40418 1
40473 2	42741 7	43145 5	43602 9
	44122 6	45407 0	

C

64619 2	65807 2	68156 7	68240 5
69625 3	70519 0	75473 7	

I wish to record my heartiest thanks to Dr P K Kichlu, who has always taken a kind interest in my work and has helped me with many valuable suggestions

D P ACHARYA
B N College, Patna,
Dec 19

Further Triplets of Trebly Ionised Arsenic (As IV)

SAWYER and Humphreys (*Phy Rev*, **32**, 580, 1928) have identified three triplets due to the combination of the term $4s4p\,{}^3P$ with $4s5s\,{}^3S$, $4s4d\,{}^3D$, and $4p^2\,{}^3P$ of the spectrum of trebly ionised arsenic In the course of the study of the spectrum of arsenic under different conditions of excitation, I have found two more triplets due to As IV, the details of which are as follows:

	λ		ν	$\Delta\nu$	
$5sS_1 - 5pP_2$	3109 01	(5)	32155 4	816 5	
$5sS_1 - 5pP_1$	3190 00	(3)	31338 9	262 0	
$5sS_1 - 5pP_0$	3216 90	(2)	31076 9		
$4dD_1 - 5pP_0$	2461 37	(3)	41615 5		261 7
$4dD_2 - 5pP_1$	2453 93	(4)	40738 6	138 6	
$4dD_1 - 5pP_1$	2445 61	(1)	40877 2		816 3
$4dD_3 - 5pP_2$	2417 49	(5)	41352 6	202 3	
$4dD_2 - 5pP_2$	2405 72	(2)	41554 9		
$4dD_1 - 5pP_2$					

Taking Sawyer and Humphreys' value, 199087 for $5sS_1$, the values of $5pP_{012}$ are 168010, 167748, 166932 The observed and calculated positions of the second triplet agree closely

K R RAO
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South Kensington, S W 7

Super-cooled Water

THE viscosity of water has been determined down to − 9° C, at which temperature it is quite fluid, and I was surprised to find that water drops suddenly chilled (without crystallisation) to − 17° became hard —that is, true water glass In Beilby's "Aggregation and Flow of Solids" (1921), p 195, we find "When a small drop of water was placed on a glass slip which had previously been cooled to − 12° it instantly froze and became like a hemispherical lens, perfectly transparent and colourless Under the microscope it showed no signs of crystalline structure" The term 'froze' is a little ambiguous, but from the context can only be taken to indicate hardening

Thus there appears to be a great change in the properties of super-cooled water between − 9° and − 12° It seems unlikely that this phenomenon should have escaped notice up to now, but I can find no reference to it

LEONARD HAWKES
Bedford College,
Regent's Park, N W 1

The Total Solar Eclipse of May 9

ON May 9 the sun will be totally eclipsed for a period up to more than five minutes in a belt which crosses land in Sumatra, Kedah, Siam, Cambodia, and the Philippines The length of totality and the good field of stars in which the sun is placed at totality, make this eclipse one of the best for further examination of the law of displacement of stellar images through the bending of rays of light passing close to the sun The value of the deviation predicted by Einstein was confirmed by the British observers in 1919, and by the Lick observers in 1922, but there have been indications of slight deviation from the formula proposed by Einstein for the displacements of the stellar images, and several expeditions are putting the Einstein experiment in the forefront of their programmes The main subjects of other researches are spectrophotometry of chromosphere and corona, direct photography of the corona to examine structure and internal motion, interferometer observations for exact wave lengths of coronal lines and rotation, photometry and studies of polarisation

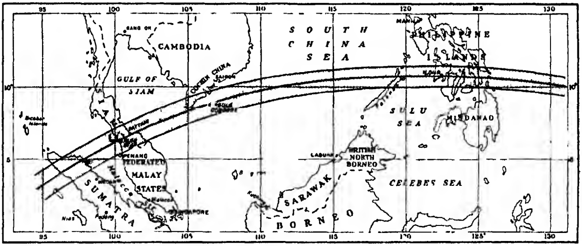

FIG 1—Track of total solar eclipse of May 9 1929

In Sumatra, which is to see a total solar eclipse for the third time this century, there will be two or three expeditions A Dutch expedition, including Dr Minnaert, who was successful in Sweden in 1927, will probably go to the north-east coast near Idi They will study the solar radiation near and through totality, and the spectrophotometry of the chromosphere and corona The party may be joined by a German expedition from Potsdam, which will attack the Einstein problem with an astrographic telescope and also with a cœlostat with two camera tubes—taken out to Sumatra by Dr Freundlich in 1926 The German expedition will also aim at securing improved wave-lengths for the coronal lines by using a spectrograph of high dispersion and will work on the relative intensities of these lines An American expedition under Prof. Miller, of Swarthmore College Observatory, will also attack the Einstein problem, will take a number of direct photographs with a tower telescope of 62 ft focal length for coronal structure, and will try for exact wave lengths of the corona by the use of an interferometer This expedition will probably be at or near Idi on the north east coast of Sumatra

In Kedah, a Malayan State, there will be a British expedition, probably at Alor Star Dr Jackson, of the Royal Observatory, Greenwich, will carry out the Einstein experiment with a cœlostat feeding a 7 inch lens of 21-ft focal length, while Dr Carroll and Dr Aston, from Cambridge, will work on spectrophotometry with a moving plate spectrograph and on motion in the corona by means of an interferometer, applying the method used on the Orion nebula by Fabry and Buisson Direct photography of the corona with a 6-inch lens of 45 ft focus, and through colour screens with short focus cameras, will also be carried out

The other British expedition—Prof Stratton, of Cambridge, with Mr Melotte, of Greenwich—will repeat the study of the relative intensity of the H and K lines and the infra red triplet of ionised calcium by means of a Littrow grating spectroscope, in order to test Milne's theory of the chromosphere, and will also repeat the Einstein experiment, using the Greenwich astrographic telescope and the mounting prepared for the Christmas Island eclipse of 1922 Direct photographs of the corona will be made with the 4 in lens of 19 ft focal length belonging to the Royal Irish Academy but used at a succession of eclipses, and the flash spectrum will be obtained with this instrument and with a direct vision prism lent by the Royal Observatory, Edinburgh In addition, a polariscopic study of the corona will be made with the Nicol prism used in the past by Prof Newall Dr Royds, of Kodaikanal Observatory, Profs. Kibble and Barnes, of Madras, Col. J Waley Cohen and Mr E G Barton are expected to join this party The last-named has been travelling in China and Burma since the

eclipse of 1926, where he was a member of the British Expedition to Benkoelen

In Kedah or Siam there will probably also be an American expedition from Harvard, Prof Stetson and Mr Weld Arnold, with a programme of photometry—absolute and relative—and direct photography of the corona, and near Khoke Bhode, in Siam, there may also be a German expedition from Kiel and Göttingen Their programme will include photometry and spectrophotometry of the chromosphere and corona and a search for faint coronal lines with a spectrograph of high light-gathering power

On Poulo Condore, an island off the coast of Cambodia, there will be a French expedition from the Bureau des Longitudes Coronal photometry and the Einstein experiment will form the main programme At Iloilo, in the Philippines, a German expedition from Hamburg will be established with a programme including objective prism flash spectra and direct photography of the corona with a series of exposures of different lengths It is possible that Anderson's apparatus may also be taken to the Philippines by a joint American and Norwegian expedition, mainly from the Naval Observatory, Washington

The weather prospects along the whole belt are reasonably good, and with so many parties so well spaced along the belt of totality, it may be hoped that important results will be obtained in the whole field of eclipse problems of present day interest

The Structure of Atomic Nuclei.

IN opening the discussion on atomic nuclei, held at the Royal Society meeting on Feb 7, the president, Sir Ernest Rutherford, directed attention to a former meeting, held at the Royal Society in March 1914, when the existing evidence on the nuclear structure of the atom was set out The speakers at that meeting included the president as opener of the discussion, Moseley, Soddy, Nicholson, Hicks, H S Allen, and Sylvanus Thompson It is of interest to note that at this meeting Moseley gave his final conclusion on the classification of the elements by their ordinal numbers, and that Soddy, after giving the evidence for the existence of radioactive isotopes, suggested that many of the ordinary elements might also consist of isotopes, a result so completely confirmed in later years

The experiments described at that meeting in 1914 tended to show that the nucleus was to be regarded as a point, but in the intervening years evidence from a variety of sources has been accumulated which throws light on the structure of this minute central body Sir Ernest directed attention to the three main lines of attack the measurements of the masses of atoms, the evidence from collisions of α particles with nuclei, and the evidence provided by the natural disintegration of the radioactive elements He emphasised that, while many nuclear phenomena have been observed and investigated in the last decade, only one way of influencing the nucleus directly has been discovered Although many attempts have been made to disintegrate the elements artificially, the only agents which have as yet accomplished this are the α particles emitted by radioactive bodies The α-particles are helium nuclei with energies as high as seven million electron volts, and, when their direction of impact on an atom is central, they can penetrate the atom and collide with the nucleus, thereby disintegrating it

One of the most fruitful lines of investigation has proved to be the observation of the deflection α-particles suffer when they pass near the nucleus but yet do not disintegrate it This scattering, as it is termed, is due to the electrical forces between the α-particle with two elementary charges, and the nucleus with Z elementary charges, where Z is the atomic number The α particles which penetrate closest to the nucleus are most deflected, so that conversely by observing the relative number of particles deflected at a certain angle, information can be obtained about the electrical forces between the particles for a definite distance of approach It can be shown that the variation of the scattering at a definite angle as the velocity of the particle is changed gives direct information on the rate of variation of the electrical forces with distance

An extended series of experiments on these lines has been made by Rutherford and Chadwick, and the results have shown that for the elements from copper (atomic number 29) to uranium (atomic number 92), the law of force is that of the inverse square The closest distance of approach of the particles to the nucleus in these experiments was 10^{-12} cm in the case of copper, and about 4×10^{-12} cm with uranium The fact that no deviations from the inverse square were found indicates that for these distances of approach the two charged bodies are acting as points, and no information can be deduced about the dimensions of the nucleus except that it must be smaller than these distances With lighter elements quite different results are obtained Owing to the smaller nuclear charges, the α particle can approach much nearer to the nucleus and marked deviations from the scattering expected on the inverse square law are observed The most natural explanation of the results is found to be that, at very close distances, attractive forces come into play varying rapidly with the distance The experiments are not as yet sufficiently definite to determine the rate of variation in detail Debye and Hardmeier have attempted to put the existence of these forces on a physical basis by suggesting they are due to distortion or the mutual polarisation of the colliding particles It appears that this hypothesis can give a general explanation of the scattering by light elements

An extremely important application of these scattering experiments is obtained by considering the results with uranium On ordinary views, part at least of the energy of the α particle ejected from the uranium nucleus must be due to the repul-

sion of the inverse square law forces If its entire energy is attributed to this cause, a minimum estimate will be obtained for the distance at which the inverse square force of repulsion begins to be appreciably diminished by the attractive forces The calculation yields a value of 6×10^{-12} cm, this is in complete disagreement with the scattering result already quoted, which showed that the inverse square field extended down to a distance of less than 4×10^{-12} cm This impasse is avoided if we may make use of the wave mechanics

Dr J Chadwick described a similar phenomenon which is found to occur with aluminium, which is almost at the other end of the table of elements Aluminium is one of the elements which can be disintegrated by the impact of α particles, and, as would be expected, the probability of disintegration decreases as the speed of the α particle is decreased Measurable disintegration, however, is still observed with α particles of such low speed that the scattering observed in other experiments is still due to inverse square law forces In one experiment, α particles of this speed appear to be able to hit the nucleus so as to disintegrate it, but yet in the other the same speed α particles are deflected as if the nucleus acted as a point charge

Both these results can be explained at least qualitatively, according to the wave mechanics, in a manner suggested independently by Gurney and Condon, and by Gamow It is supposed that the repulsive inverse square law field surrounding the nucleus extends down to very small distances, of the order of 0.7×10^{-12} cm for uranium, and rises to a peak value of the order of thirty million volts The scattering results are therefore directly understandable The reason why a slow particle can escape from the uranium nucleus, or in the other case penetrate into the aluminium nucleus, is to be sought for in the peculiar properties ascribed to particles by the wave mechanics On the classical theories, the only way a particle can pass from one region into a second separated from the first by a potential barrier is by surmounting the barrier On the wave theory, however, there is a finite probability of the particle passing through the potential barrier although its energy may be far less than the peak value

Several points of exceptional interest have been discovered in connexion with the artificial disintegration of the elements With the exception of lithium, beryllium, carbon, and oxygen, all the elements up to potassium can be disintegrated by the α particles of radium C (energy seven million electron volts) Particular attention had been directed to the energy relations occurring in the collision For example, it is found that protons are knocked off the aluminium nucleus with energies as high as 1.4 times that of the incident α particle The experiments of Blackett have shown that in the process of artificial disintegration of nitrogen, while a proton is knocked off, the α particle appears to be captured. If this is also the case in the disintegration of aluminium, it is possible to deduce from the experiments that what may be termed the heat of the reaction is not constant, but varies over a comparatively wide range The obvious suggestion is that the masses of all aluminium nuclei are not identical

The elements of odd atomic number give protons of greater range than those of even atomic number, and this distinction between the two classes was emphasised by Dr F W Aston in connexion with his experiments on the isotopic constitution and masses of the elements While the even atomic numbers often have many isotopes (tin has eleven), the elements of odd atomic number appear never to have more than two

Valuable evidence on the stability of the elements is provided by the accurate measurements of their masses by the mass spectrograph The mass of a nucleus is in general found to be less than the sum of the masses of the protons, α-particles, and electrons of which it is supposed to be constituted This disappearance of mass represents an emission of energy in its formation, or conversely, that energy must be supplied to disintegrate it The measurements so far carried out support both the results on the artificial disintegration and the occurrence of natural disintegration for elements of high atomic number For example, with the radioactive elements it appears likely, as was pointed out by Sir Ernest Rutherford, that the α particle has more mass inside the nucleus than when it is free

Mr R H Fowler gave an account of the developments of Gamow's theory, which has already been referred to It has been seen how the experimental evidence leads to the conception of attractive forces at close distances giving rise to a potential barrier surrounding the nucleus as shown in Fig 1 The problem is how constituents of

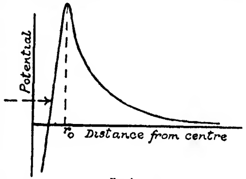

FIG 1

the nucleus such as α particles which are inside this nucleus can escape, when their energy as represented by the arrow is insufficient to take them over the peak An α particle inside such a nucleus is not to be considered as a material particle executing some kind of orbital motion, but as a wave motion filling the whole of the space The wavelength is determined by the momentum of the α-particle, and as a rough illustration, the stable states are those in which some type of stationary wave system exists If the potential barrier were infinitely thick or high, it would be possible to have a true stationary wave motion and the

system would be permanently stable With a finite barrier, the wave motion on the new mechanics is found to be a damped vibration coupled with an issuing wave which penetrates the barrier The exact optical analogy is a wave incident at an angle greater than the critical angle on a surface only a few wave-lengths thick In this case it has been shown experimentally that a small amount of the wave penetrates the surface The issuing wave in the nuclear problem must be interpreted as showing that the α particle has a possibly small, but yet finite chance of escape from the system with the same energy that it has inside the nucleus This is in itself the explanation of radioactive disintegration, but the calculation can be pushed much further It will be seen from Fig 1 that the greater the energy of the α particle the smaller the thickness and height of the potential barrier it has to penetrate, and the greater should be the chance of escape, that is, disintegration This is the well known Geiger-Nuttall law connecting the energy of the ejected α-particle with the transformation constant Considering the pro visional state of the theory, an excellent quantitative account can be given of the observed con nexion between the energies of the α particles and the transformation constants The distance r_0, about $0 7 \times 10^{-12}$ cm for heavy nuclei, may be looked on as the size of the nucleus, and it is found necessary to allow this to decrease as we go down the series This is, of course, reasonable

It has as yet not been possible to include the nuclear electrons in this theory, or to attempt an account of the β- and γ-ray phenomena The evidence on this subject was described by Dr C D Ellis The γ rays are high frequency electromagnetic radiations emitted immediately after the departure of the disintegration particle and can be considered as the result of the adjustment of the nucleus to the new conditions They constitute the characteristic spectrum of the nucleus and will no doubt provide valuable information on its structure, but at present there is difficulty in deciding how they are emitted It appears unlikely that they can be emitted by electrons, but there is still the choice between the positive particles and the nucleus as a whole by some process such as rotation There is clear evidence that the γ-rays can be associated with a level system, and while it may be difficult to fix the system from pure energy considerations, measurements of the intensities should enable a decision to be reached

A phenomenon indicating a coupling between the nucleus and the outer electronic structure has been observed by G H Aston and Ellis. The energy of the excited nucleus is not always emitted in the form of radiation, it is sometimes converted inside the same atom and leads to the ejection of an electron from the atom If the probability of this happening were to vary smoothly with the frequency, the process would be similar to the actual emission of the energy from the nucleus and reabsorption by the electrons The two systems cannot be considered distinct in this way, since the probability of conversion is found to oscillate rapidly in ascending the scale of frequencies

Prof O W Richardson pointed out that spectroscopic evidence has an important bearing on the question whether the nucleus is in rotation He described an *a priori* argument which makes it probable that the nuclei of the elements must in many instances be rotating In the case of hydrogen, the result of this argument is almost a certainty A universe is imagined which at a certain instant consists of one electron and one proton, and these unite to form an unexcited hydrogen atom with the emission of radiation The spectroscopic evidence is overwhelming that in the ground state of an atom each extra-nuclear electron has half a quantum of angular rotation If the postulated universe is to obey the principle of the conservation of angular momentum, the nucleus of the hydrogen atom must have acquired half a quantum of angular momentum in the opposite sense An improbable but interesting alternative is that the emitted radiation preserves the conservation of momentum by having a sufficiently high degree of elliptical polarisation

There is good spectroscopic evidence that the nuclei of a number of elements are rotating and have a quantised angular momentum This is shown from the magnetic field resulting from this rotation, which causes the hyper-fine structure of the spectral lines of many atoms A sufficient analysis has already been made for bismuth and cæsium to indicate the exact number of quanta on the nucleus The spectroscopic evidence of the alternating intensities in the band spectrum of hydrogen, and the specific heat of hydrogen gas, when interpreted according to the wave mechanics, also definitely require the proton to have half a quantum of angular momentum

Obituary.

DR H J H FENTON, F.R S

THE death of Dr H J H Fenton, formerly lecturer and demonstrator of chemistry in the University of Cambridge, will be regretted by many generations of Cambridge men, for he taught in the University for more than forty years, and of the numbers that have attended his lectures there can be few who did not receive a lasting impression from his teaching

Henry John Horstmann Fenton was born at Ealing in 1854 After having been educated at Magdalen College School, Oxford, he went to King's College, London, where he studied chemistry under Bloxam, and at the end of his course acted as demonstrator About this time the Clothworkers' Company instituted an exhibition in physical science tenable for three years by a non-collegiate student at Cambridge The first award

of this exhibition was made to Fenton, and he entered the University of Cambridge in the Lent Term, 1875 He afterwards gained an entrance scholarship at Christ's College, where he was admitted in May 1876 After the relative freedom of his London course he chafed at the discipline then imposed on undergraduates, with the result that he not infrequently came into conflict with university and college authorities He took the Natural Sciences Tripos in 1877, and was placed in the first class, among his contemporaries placed with him in this class were Adam Sedgwick the zoologist, Bower the botanist, and Alex Hill, afterwards master of Downing

Fenton was soon appointed an assistant demonstrator by Liveing, and when the then University demonstrator of chemistry, John Wale Hicks, of Sidney Sussex, afterwards Bishop of Bloemfontein, retired, W J Sell was appointed to succeed him, and an additional demonstratorship of chemistry was instituted by the University and the post assigned to Fenton

This was in the days of the old Chemical Laboratory, which stood on the east side of the site of the former Botanic Garden and afterwards served as part of the Pathological Laboratory Several of the colleges then had their own chemical laboratories, and these were run in competition with the University laboratory This competition continued for many years after the erection in 1887 of the new University Chemical Laboratory in Pembroke Street, though in an ever-lessening degree as the college laboratories one by one were given up The greater part of the teaching in the University laboratory was carried out by Sell and Fenton, and in spite of their different temperaments the two men worked together in harmony until their association was terminated by the death of Sell in 1915

Fenton's lectures were for many years an outstanding feature in the instruction given in the University Laboratory He took immense pains in their preparation, and although in lecturing he affected an air of boredom and a somewhat indolent manner, actually he delivered them with very great care, and he was extraordinarily successful in stimulating the interest of the abler men He was scrupulous in avoiding dogmatism, and he endeavoured, so far as possible, to present every subject as a debatable question on which there were diverse views to be discussed The value of his lectures was greatly enhanced by the informal discussions which he encouraged, at the close of every lecture a number of eager young men would come down to the lecture table and discuss with him, often for half an hour or more, the questions in which he had aroused their interest

The course of experimental work in general and physical chemistry which Fenton devised to illustrate his lectures was very carefully thought out, and during the 'eighties, and even later, the type of laboratory work being done by his class was probably unique Of his books, his "Notes on Qualitative Analysis," which was widely used, and his "Outlines of Chemistry," of which Part I only was published, are best known

Although Fenton's chief interest always seemed to lie in general and physical chemistry, the greater part of his original work was carried out in organic chemistry and his most important investigations centred round dihydroxymaleic acid He was led to the discovery of this compound in a curious way, whilst demonstrating one day he found that a student amusing himself by mixing a number of reagents selected at random had obtained a remarkable purple coloration Fenton realised at once that the observation was one that should be followed up, and he found that the colour was due to the iron derivative of an oxidation product of tartaric acid Several years later he succeeded in the difficult task of isolating this product, and showed that it was the previously unknown compound, dihydroxymaleic acid In a series of elegant investigations, carried out in part with the assistance of his students, he described numerous interesting transformations of this substance, and also established the value of hydrogen peroxide in the presence of iron salts as an oxidising agent

Fenton was elected into the Royal Society in 1899, and served on the Council of that body from 1913 until 1916 He was made an honorary fellow of his College in 1911 He was naturally a shy man and was exceedingly sensitive to chaff or criticism, he endeavoured to conceal his shyness by assuming a certain *hauteur* which tended to repel some of those who would have sought his friendship He had a very strong sense of fairness, but his pertinacity in defending views in which he was in a minority of one sometimes made him a difficult member of University bodies He married in 1892, Edith, daughter of George Fergusson of Richmond He left no children He gave up his lectureship in 1924 and went to live at Hove, but the last years of his life were greatly clouded by illness He died in a nursing home in London on Jan 13, at the age of seventy four

C T H
W H M

Prof R H Yapp

We regret to record the death on Jan 22 of R H Yapp, Mason professor of botany in the University of Birmingham, after a year of suffering borne with heroic fortitude and patience His untimely death at fifty seven years of age is all the more tragic as the new and extensive laboratories, which he had planned with such care and thoroughness, had only just been opened before he was taken seriously ill, and he was thus unable to complete a number of investigations which had been temporarily laid aside for the exacting duty of supervising the erection of the greatly needed new department

Richard Henry Yapp was born in the village of Orleton, in Herefordshire, in 1871, and was educated at a school in Hereford, and later at Nottingham After spending some years in the firm of Messrs Alexander and Duncan in Leominster, he entered St John's College, Cambridge, as a scholar, and graduated with first class honours in botany in 1898 Elected to the Frank Smart Studentship

at Gonville and Caius in 1899, he was appointed botanist to the University of Cambridge scientific expedition to the Malay States under the leadership of Mr W Skeat Of the interest aroused in him by this expedition he always spoke with warm recollection, and the material collected formed the basis of several investigations published in the *Annals of Botany*

In 1904, Yapp was appointed to the chair of botany in University College, Aberystwyth, and during the ten years of his tenure of that professorship he reorganised and extended the botanical department, and enriched its museum with many specimens collected in the Malay States and in South Africa, during his visit to that country with the British Association in 1905 From Aberystwyth, Yapp went to Queen's College, Belfast and in 1919 to the University of Birmingham In all three places he threw himself with vigour into the teaching and reorganising of his department, and by his active interest in the general welfare of the college or university to which he was attached, he invariably gained the confidence and esteem of his colleagues, and was trusted as a clear sighted adviser Though this brought him many and exacting duties, he managed to accomplish a considerable amount of research work which was latterly of a physiological and ecological nature

While still at Cambridge, Yapp had become interested in the fens, and spent many holidays studying the peculiarities of their vegetation As a result of these studies he published a detailed account of the vegetation of Wicken Fen, dealing more particularly with the relation of the plants to soil moisture This was followed by a critical account, structural, physiological, and developmental, of the foliage of the meadow sweet (*Spirea Ulmaria*), as bearing on the problem of xeromorphy in marsh plants In this question of the water-relation of plants his interest continued to the very end, and during his last illness he was busy editing the English translation of Prof Maximov's book on this subject, and also writing up voluminous notes of investigations carried out by himself some few years ago

While at Aberystwyth, Prof Yapp became interested in the various plant associations of the Dovey estuary, and made a special study of the vegetation of the salt marshes Detailed accounts of this investigation were published in the *Journal of Ecology* in 1917 and 1921 These ecological studies necessitated the consideration of the general inter relationships of plants in vegetation, and led to the publication of two critical papers on the "Concept of Association" and the "Concept of Habitat" respectively Had he been spared to work out other important ideas for which he was collecting evidence, Prof Yapp would have still further enhanced his reputation as a careful observer and a clear thinker In recognition of his ecological work he was elected president of the Ecological Society in 1921, and he was looking forward with eagerness to presiding over the botanical section of the British Association at the meeting in Glasgow last autumn, when his fatal illness necessitated his resigning the presidency of the section Though aware of the probable fatal termination of his illness, he never lost courage, and continued as long as it was possible to work at the completion of some of his botanical investigations

Yapp possessed a clear and orderly mind, and had the ability to present lucidly and tersely the information he wished to convey Good evidence of this is afforded not only by his published researches, but also by the success of his small text book on botany published by the Cambridge University Press He leaves a widow, who tended him with touching devotion during his prolonged and painful illness, and two children, a son and daughter By his death the University of Birmingham loses a valued teacher, and science an ardent investigator and a gifted botanist His botanical colleagues will remember him as a genial friend, of innate modesty and of singular personal charm

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Fräulein Gerda Laski

Fräulein Gerda Laski, who was one of the few women to succeed in making a name for herself in the realms of the exact sciences, died in Berlin on Nov 24 Coming of a well to do family in Vienna, her attention was liberally directed from the first towards the arts and sciences, a fact which, combined with a natural vivacity and affectionate temperament, endowed her with great versatility, and added in no small degree to the charm of her personality

Fräulein Laski studied for her doctorate in Vienna at the Physical Institute under Prof Ehrenhaft, and her first published work—on sub-microscopic particles—was a direct result of the intellectual circle in which she was placed After a period at Göttingen (where Debye then was) she became assistant in the Physical Institute of the University of Berlin, where she was introduced by Rubens to the experimental technique of infra red research This subject had attracted her during her sojourn in Göttingen, and, broadly speaking, it remained her chief interest to the end In 1924, Fraulein Laski was chosen to take charge of the department of infra-red research in the Kaiser Wilhelm Institute für Faserstoffchemie at Dahlem

In addition to various publications dealing with her own investigations (such as the long wave-length spectrum of mercury vapour, the infra red spectra of chlorates and bromates, and of cellulose), Fräulein Laski contributed the article on infra red research to vol 3 (1924) of the "Ergebnisse der exakten Naturwissenschaften" Her last work comprised a couple of chapters, "Special Methods for Measurements in the Infra red" and "Thermo-electricity" for the Geiger-Scheel "Handbuch der Physik"

Fräulein Laski's death while in the prime of life has removed a talented research worker, and at the same time many will regret the passing of a colleague who had endeared herself to a wide circle of friends

News and Views.

METEOROLOGICAL statistics justify, on the whole, the selection of Aldwick, near Bognor, as the place of convalescence for His Majesty the King, when it is borne in mind that sunshine is the element of greatest importance in such a case Bognor lies within the only strip of the south coast of England where the general average daily duration of sunshine in the month of February exceeds three hours The contrast between the figures for this Sussex watering place and those for St James's Park are most striking for mid winter, but even in this month, with its lengthening days, the relative amounts are not far short of three to one In March the ratio is reduced to almost exactly two to one, and by April the advantage of the seaside place is reduced to 45 per cent The particular merit of the climate of the Sussex coast is that it combines a low average rainfall with its abundant sunshine, and in this respect has a great advantage over the southern coasts of Devon and Cornwall On the other hand, the south west coast has a slightly higher mean temperature, due to the fact that it is more frequently under the influence of the mild southerly or south westerly winds of the Atlantic, at the same time that the south east of England is meteorologically one with the Continent during a spell of the cold easterly type of weathor A curious fact—perhaps not widely recognised—is that in spring the warmth derived from artificial sources in London on the one hand, and the influence of the cold sea upon the coastal climate on the other, are sufficient to make St James's Park actually warmer than Bognor when shade temperature alone is considered The difference amounts to about a degree and a half

CENTRAL Europe is in the grip of an intense anti cyclone, and over northern Russia pressure exceeds 1044 millibars, which is 30 millibars above the normal for the month Usually during February the axis of high pressure lies to the south, over Switzerland and the Balkan highlands, and the greater part of Europe comes under the influence of rather mild westerly and south westerly winds from the Atlantic Under the conditions existing at present, however, pressure is highest in the latitude of the Baltic, and winds are easterly over almost the whole of Europe, from the Black Sea and the Alps to the North German coast The anticyclone is an offshoot of the great winter anti cyclone of Siberia, and the source of the air is away in central Asia Reports in the press quote some extra ordinarily low temperatures, such as $-67°$ F at Ivanov Voznesensk, north-east of Moscow, and per haps even lower at other places in central Russia, $-40°$ F near Vilna in Poland, $-31°$ F in Silesia, $-24°$ F in Belgrade, and $-15°$ F in Berlin The last, if correct, is the lowest temperature recorded during more than a hundred years' observations in that city, the previous lowest having been $-13°$ F in 1850 and 1855

THE lowest temperatures hitherto recorded near Moscow are probably not below $-50°$ F, and the low minima quoted above are not confirmed by figures in the *Daily Weather Report* The western Baltic is freezing, and many ships are fast in the ice Vienna is also intensely cold, and the Danube is frozen for 1200 miles The cold extends across south-eastern Europe to Asia Minor and Syria, and there have been several heavy falls of snow in the Balkans, associated with a deep depression which occupied the eastern Mediterranean at the end of January and beginning of February The deep drifts have blocked the railway line to Constantinople, and three Simplon express trains with a number of passengers have been snowed up for a week in Thrace

IN response to the invitation of the Royal Institu tion, representatives of many scientific and technical societies met in the famous lecture theatre in Albe marle Street on Feb 5, to consider the preliminary arrangements for the celebration of the centenary of Faraday's great discovery of electromagnetic induction, which he made on Aug 28, 1831 Sir Arthur Keith was in the chair, and in opening the proceedings reminded those present that the Royal Institution was not only the scene of Faraday's labours, but it was also for more than half a century his home Sir William Bragg, director of the Royal Institution, said that the proposed celebrations had been in mind a long time, and in choosing the particular discovery of August 1831 they were recalling one of Faraday's most important discoveries, on which rested a vast body of scientific and industrial development The occasion would give the nation an opportunity of realising the contributions to science and industry during the last hundred years It was unlikely there would be another occasion so favourable, and if made a success, the centenary would encourage the people to go on with their work and brighten the whole outlook of the nation

AMONG the speakers was Sir Ernest Rutherford, who not only approved the suggestions but also pointed out that in 1931 occurs the centenary of the birth of James Clerk Maxwell, who in a sense was Faraday's interpreter and put into mathematical form the latter's views Col K Edgcumbe, president of the Institution of Electrical Engineers, Sir John Snell, Sir William Pope, Mr D N Dunlop, Sir John Reith, Col W A Vignoles, and Prof J L Myres all promised the co operation of the societies they represented Prof Myres made the interesting announcement that the officers of the British Association were prepared to recommend to their Council that the centenary meetings of the Association of 1931 should be held in London, and said they would be glad to do everything in their power to ensure that not only the intellectual descendants of Faraday himself, but also the large public interests which benefited from the applications of those discoveries, should be represented The meeting approved the appointment of two small committees to deal with the scientific and industrial sides of the celebration, which Sir William Bragg announced would probably take place in the third week of September 1931.

Two donors, who desire to remain anonymous, have each presented the London Hospital with a gram of radium for work on cancer Following so soon after the generous gift of radium to the King Edward Hospital Fund by Sir Otto Beit, these gifts are adequate testimony to the conviction that is gaining ground of the good results which follow the use of radium in the treatment of cancer Conditions were laid down by Sir Otto Beit that his radium should be loaned to centres where the study of radiation questions is carried out on scientific lines One of the London Hospital donors has supplemented his gift by an additional £13,000, which is to be invested and the income from it used in running a radium laboratory The radium and the endowment are to form a trust known as the Freedom Radium Trust, and this Trust is to be managed by a committee of three 'governors,' who have power to co opt members of the honorary surgical staff The number of cancer cases treated at the London Hospital is 800 1000 a year, and steps are being taken for complete records of all the cases which will be treated under these new opportunities

A PROJECT to perpetuate the memory of the late Drs Peach and Horne has been recently inaugurated in Edinburgh Benjamin Neeve Peach died in January 1926, and his lifelong friend and fellow worker, John Horne, followed him in May 1928 In response to a widely expressed desire that the eminent services rendered to geology by these two distinguished men of science should be recognised in some appropriate form, a representative committee was convened and has now decided to take steps to raise a joint memorial The committee, which is under the chairmanship of Prof R A Sampson, includes delegates from the Geological Survey of Great Britain, the Royal Scottish Museum, the geological departments of the Scottish universities, and the following scientific societies with which Drs Peach and Horne were most closely associated Royal Society of Edinburgh, Royal Scottish Geographical Society, Royal Physical Society of Edinburgh, and the Geological Societies of Edinburgh and of Glasgow The committee proposes, with the concurrence of the authorities concerned, that the memorial shall take the form of a bronze plaque to be placed in a suitable position in the Royal Scottish Museum, Edinburgh, and of a commemorative inscription upon some conspicuous rock face or boulder at one of the classical geological localities in the north west Highlands A fund has been opened to defray expenses, and the committee has appointed Mr M Macgregor, Southpark, 19 Grange Terrace, Edinburgh, to receive and acknowledge all contributions

NEWS of another find of skeletal remains of early man in Africa is to hand It is reported that during quarrying operations in Springbok flats in the northern Transvaal, fossil bones of man have been found in conjunction with the remains of an extinct gigantic buffalo According to the Pretoria correspondent of the *Times*, in a dispatch which appeared in the issue of Feb 9, the skull, long bones, and parts of the hands have now been found, but most of the vertebral column and the entire pelvis are missing The skull and the other bones have been much broken, as if the hunter had been trampled by the buffalo It is stated that the remains are those of a large size man not closely related to the negroid type The marked supra-orbital ridges of Rhodesian man are absent, but the lower jaw, though protuberant, has only a small chin, while the teeth are said to resemble those of Rhodesian man This description would scarcely appear congruous with the attribution which is stated to have been put forward with confidence that the remains are of the Cro Magnon type, and a possibility which is hinted that they may prove to be more primitive seems very likely

DR BROOM is reported in a later dispatch as regarding the Springbok man as proof of the existence of a primitive pre negroid type in South Africa, and as establishing the hitherto doubtful standing of the Boskop skull Whether this be the case or not, the find certainly seems likely to prove of very considerable importance The absence of the supra orbital ridges would clearly distinguish these remains from those of Rhodesian man, and they would thus add another to the early physical types which appear in the south of the continent This range of type, of which unfortunately at present there is no evidence to fix the chronological sequence, would be in harmony with the archæological evidence which, according to the latest analysis, points to a succession of infiltrations into the sub continent from the north

ON p 262 of this issue, we publish a summary account of Miss Garrod's recent presidential address to the Prehistoric Society of East Anglia, in which she gives a 'new view' of prehistory It has for some time been evident that the results of archæological discovery outside the western European area could be brought within the classical order of de Mortillet only with increasing difficulty This has perhaps been most impressed upon archæologists by the discoveries of Fathers P P Licent and Teilhard de Chardin in China A full and exhaustive report on these discoveries has been issued by the Institut de Paléontologie humaine of Paris M Boule and the Messrs Licent and Chardin themselves alike agree in regarding their discoveries as of vital import in the interpretation of the succession of palæolithic cultures in the West Both geology and palæontology are now held to point to parity of conditions within a range extending from China to western Europe Yet cultures which in the West appear in chronological succession, in the East appear to co-exist Middle and Upper Palæolithic are combined Hence such distinguished archæologists as M Boule, the Abbé Breuil and Prof Obermaier are coming to regard the succession of cultures in the West as a localised and peculiar condition due to a series of incursions from a centre of dispersion for which they look to Asia It is interesting to note that the account by M H Martin of Solutrean frescoes found in a rock shelter in the valley of the River Roc (Charente) and the deductions he draws therefrom favour Miss Garrod's view as to the extent to which the Solutrean penetrated the

West It is clear that Miss Garrod's plea for extended exploration in extra European areas does no more than justice to the situation

In spite of a substantial reduction in its income, the Empire Cotton Growing Corporation is continuing its scientific research in the cotton plantations (see Nature, Nov 5, 1927, p 645, and Mar 10, 1928, p 362) The quarterly report of the Executive Committee, which met on Jan 23, makes this quite clear, as the following items show The jassid resisting strains of cotton evolved at the Barberton Experiment Station have reached the stage of rapid multiplication for distribution to the farmers, and are fully maintaining the high opinion formed of them A number of them have been found to be early maturing —always a matter of first importance with regard to insect pests in warm climates Similar work has now been undertaken in Southern Rhodesia, and there is already a promise that cotton growing will shortly enter into regular rotation with other crops Considerable attention has been directed lately to the important research work being done in the Sudan A committee was formed in this country to overhaul this work, and its decision was most favourable to its high scientific character

Special studies are being made by the Empire Cotton Growing Corporation on the black arm disease of cotton, with the result that a very definite correlation has been observed between this fungus and soil temperatures By regulating the time of planting to periods when the soil temperature is unfavourable to the development of the fungus, it is hoped that a considerable measure of control will result A fresh appointment has been sanctioned to assist the pathologist in his work Research in Nyasaland has sufficiently advanced to justify the opening of a station on the west side of the lake Here the country appears to be specially suited for cotton growing, and will shortly be rendered accessible by the extension of the railway from Blantyre to the lake Meanwhile, the research station in Trinidad is getting into its stride, and important papers have been and are being published in both the genetic and physiological sections The papers issued have won warm eulogies from scientific men in Great Britain, in the United States, and on the continent of Europe

In the second lecture of his course on "The Early History of X rays," delivered at the Royal Institution on Feb 7, Sir William Bragg said that, like many other physicists of the same period, Röntgen was interested in the electric discharge in all the new forms which were being given to it by improvements in technique and especially by the increasing efficiency of the means for producing high vacua Crookes, Hittorf, Lenard, and others had shown the marvellous properties of the so called cathode rays An additional factor in the discovery was the results of investigations with various phosphorescent substances All the circumstances were therefore in favour of the discovery being made, and to Röntgen fell the honour of being the first to grasp the significance of an effect that others must have occasionally seen, and indeed did see about that time His discharge tube was wrapped in black paper, yet one of these phosphorescent materials was set glowing when the discharge was made to pass He also observed with curiosity that it made no difference whether the cardboard sheet on which his fluorescent material was spread was held with its back or front to the bulb He assumed that a kind of ray, hitherto unknown, was emanating from the bulb From that he went on to discover all the principal features of the rays and presented them in a paper of singular lucidity and order All over the world delighted workers repeated his experiments In Great Britain, J J Thomson, Campbell Swinton, Schuster, Porter, Jackson, and others helped in the rapid development of a new technique The wonder of X-rays is now widespread, but the savour of the marvel of those first experiments will never be forgotten by those who had any part in them

In his Friday evening discourse, delivered at the *Royal Institution on Feb 8, Mr C E R Sherrington* discussed "Recent Problems of Rail Transport at Home and Abroad" The retail and short distance nature of the rail traffic of Great Britain, he said, prevents the adoption of many methods used abroad, but the employment of labour saving device—the corollary of high wage rates—is extending widely Advocates of the Channel Tunnel scheme should not forget that the size of rolling stock in England is more limited in dimensions than that of Continental railways, while the practical difficulties experienced with steel sleepers abroad, such as the undesirability of using them with slag ballast, should limit their use at home to the time when they become a financially profitable improvement The reinforced concrete sleeper is an alternative to steel, and can be more easily insulated where track circuits and automatic signals are required The progress in signalling has resulted in the use of the day colour light signal, widely developed on the Southern Railway of Great Britain Its universal adoption is to be expected in view of its penetrative power through fog, for automatic train control has not yet achieved that degree of infallibility which warrants the enormous cost of its application, this cost in the United States has often been more than £400 a mile Freight service has been speeded up by the use of the rail-brake, now being installed for the first time in England at March, London and North Eastern Railway

Since radio broadcasting was started five years ago its growth has been remarkable Difficulties, however, are continually arising, which can only be overcome by persistent scientific research In *Discovery* for February, Sir John Reith points out that the main difficulty arises from the fact that to-day there are nearly three hundred stations in Europe trying to broadcast on a wave band which is barely sufficient for a hundred At the international conference at Geneva, Great Britain was allotted ten exclusive frequencies Had it not been for the rapid growth in the number of stations, this arrangement might have sufficed The actual result, however, is that the so-called exclusive frequencies are being encroached on

continually Two years ago the nine main stations of the B B C had an uninterrupted range of twenty miles for reception, and the relay stations had a range of five miles Owing to interference, these ranges are now reduced to five and one and a half respectively The radio engineers, therefore, are forced to erect a limited number of high power stations instead of the comparatively numerous low powered stations at present in use The proposed new stations also will have two transmitters, each capable of operating on different frequencies, so that separate programmes can be transmitted simultaneously The experimental results already obtained at the Daventry station (5GB) have proved eminently satisfactory The first of the new high power regional transmitters is being built at Brookman's Park, near London It will be in operation in the autumn of this year Preliminary steps are being taken to erect high power stations to serve the north of England, Scotland, Wales, and the west of England These will probably be completed in 1930 Until the regional scheme is ready, temporary measures are being taken to supply those listeners served by relay stations It has to be remembered that the interference from distant stations increases after sunset, and so after dark the service of a station sharing a wave length is decreased

Dr B A Keen, assistant director of the Rothamsted Experimental Station, has been giving talks through the British Broadcasting Corporation from September last on "The Why and Wherefore of Farming" The B B C has now published, as part of this course, two pamphlets illustrating and amplifying the work These pamphlets, giving a list of books to be read, and further work to be undertaken, should be in the hands of every agricultural student and teacher They contain an admirable series of photographs, designed not merely to show the fundamental scientific character of farming but also to demonstrate the extent to which modern improvements have resulted in increased supplies of food and other commodities produced from the land Especially instructive to the townsman are the illustrations of the improvements that have been effected in the types of plants grown In the second pamphlet, to accompany the course this spring, are many excellent photographs of typical English farming scenes and operations, and few will wish for anything better in the way of illustration than these Included at the end of each are instructions for the performance of simple experiments illustrating some of the more important subjects dealt with in tho lectures Appropriately enough, portraits of Jethro Tull and John Lawes form the respective frontispieces From every point of view the object aimed at seems to have been achieved The lectures have been illustrated in a most interesting way, further work on each has been suggested, the names of the books supplying the information have been supplied, and a scheme of simple practical work has been elaborated The two slight pamphlets, because of the care expended upon their production, form a very interesting complement to Dr Keen's lectures, and afford an illustration of the useful educational work which radio communication can accomplish

The rapid growth of domestic electrical installations during recent months has greatly strained the resources of the meter departments of supply stations In addition, there is no general agreement as to the type of tariff which is most equitable for the consumer and the supply company The general principles laid down by John Hopkinson many years ago still hold good, and it is probable that the universal application of a two part tariff to small users is only a question of time The difficulty that has to be overcome in all the methods hitherto suggested lies in convincing the consumer that the method of charging is an equitable one In a paper read by J L Carr to the Institution of Electrical Engineers on Feb 1, an account was given of electric meters with special reference to those which are used to record in some particular way depending on the tariff system adopted Practically all types of meters depend on their so called permanent magnets remaining always the same It is now well known that cobalt steel makes excellent permanent magnets But some makers, probably on account of the cost, still use the older types of magnet, which from the point of view of remaining permanent leave much to be desired Sooner or later every electric meter is called upon to withstand the effects of a temporary overload due to the development of some accidental fault on the circuit Every time a fuse blows, for example, there is a heavy overload It is well known that this may partially demagnetise the 'permanent magnets' and thus alter the rate at which the meter rotates for a given current The present rapid extension of the use of domestic appliances connected to all parts of the house mains will doubtless increase the frequency of short circuits Hence the effect of these on the rate of the meter is becoming important The present standard specification, namely, that the rate should not be affected when a current thirty times the normal is passed through it for half a second, is not sufficiently stringent

The present year being the jubilee year of Pope Pius XI, the Pontifical Academy of Sciences (Nuovi Lincei) has decided to offer a prize of 10,000 lire, to be awarded for the best critical dissertation on the physical theory of quanta The prize is open to al except the ordinary members of the Academy, and dissertations, which must be unpublished, are to be submitted before Oct 31 next Three typewritten copies, in either Latin, Italian, French, English, German, or Spanish, must be supplied Authors may give their own names or they may furnish a distinguishing motto, which must be repeated on a sealed envelope containing the name The award will be made, on the recommendation of a special committee nominated by the committee of the Academy, at the inaugural meeting of the next academic year in December next

Dr F C Whitmore, head of the Department of Chemistry at Northwestern University, Evanston, Illinois, has been appointed Dean of the School of Chemistry and Physics at the Pennsylvania State College as from July 1 next Dr Whitmore succeeds Dean G L Wendt, who has been appointed assistant

to the president of the College in charge of research Dr Whitmore was director of the second session of the Institute of Chemistry, held at Northwestern University last summer, and during the year 1927–28 he was chairman of the Division of Chemistry and Chemical Technology of the National Research Council He is the author of volume 3 in the mono graph series published by the American Chemical Society, namely, "The Organic Compounds of Mercury," published in 1921, and was editor in chief of vol 7, published in 1927, of the annual series entitled "Organic Syntheses"

The twenty fourth annual report of Leicester Museum and Art Gallery refers to the good work done by the Director, Dr E E Lowe, in his "Report on American Museum Work," and mentions that a new wing, to cost about £6800, will soon be available This extension will be used for exhibition space, and will contain also a students' research room and a muniment room During the year little change was made in the exhibited collections, some of which are still cramped for lack of space, but evening lectures, guide-demonstrations, and special Christmas lectures were much appreciated More than a quarter of a million visitors entered the Museum, and the running of the Museum and Art Gallery cost £7182, £6873 of which was contributed by the rates

A few years ago the Deeside Field Club, with its headquarters in Aberdeen, published as an experiment *The Deeside Field*, designed to interest the naturalist and the general reader in the many different aspects of Deeside life The success of the experiment led to the appearance of three further parts, the last of which, recently published, contains a district miscellany of wide interest and high standard Archæology is served by articles on pygmy flints, the first found in Scotland, a compendium of Deeside castles, and a discussion of Pictish symbols, natural history by accounts of the glacial geology of the Cairngorms, and of the rarer wild flowers of the valley, history by descriptions of Lumphanan and Durris, and there are many topical articles on old industries, the valley's painters, and so on The Club is performing a useful service in encouraging research into these different sides of the development of the Dee valley and its people, and in giving the results permanent record Its highly successful field excursions are no less useful in fostering acquaintance with a wide range of local interests, most of which have behind them more than local significance

It is announced in *Science* that the Penrose medal of the Geological Society of America has been presented to Dr J J Sederholm, director of the Geological Commission of Finland

The Galton Anniversary Dinner of the Eugenics Society will be held at the Rembrandt Hotel, Brompton Road, on Saturday, Feb 16, at 7 15 P M The Galton Lecture will be delivered by Major Leonard Darwin, who will take as his subject "The Coming of Age of the Eugenics Society"

As announced in our issue of Dec 8, p 898, the annual general meeting of the Chemical Society will be held at Leeds on Mar 21 The presidential address, entitled "Co operation in Science and Industry," will be delivered by Prof J F Thorpe in the Great Hall of the University at 4 30 on that date

An earthquake of moderate intensity was recorded at Kew Observatory at 17 hr 23 min 9 sec G M T on Feb 1 The epicentre is estimated to have been in Afghanistan A message from Bombay states that a shock was felt in Delhi Another disturbance was recorded at 0 hr 9 min 59 sec G M T on Feb 2 The epicentre was 4640 miles away, probably in Mongolia

The following have been elected officers of the Royal Astronomical Society for the present year *President* Dr A C D Crommelin, *Vice Presidents* Sir Frank Dyson, Dr E B Knobel, Prof H F Newall, and Rev T E R Phillips, *Treasurer* Mr J H Reynolds, *Secretaries* Prof Herbert Dingle and Dr H Knox Shaw, *Foreign Secretary* Prof H H Turner

The Ministry of Health has issued a memorandum, arranged on the same plan as in former years, of the costs incurred at residential institutions for the treatment of tuberculosis (Memo 122 B/T) The information given should be of substantial assistance to authorities in enabling them to secure economical administration of their institutions

We have received from the author, Mr F E Corrie, a pamphlet on "Iodine for Livestock" (De Gruchy and Co, Ltd, 45 Mitchell Street, E C 1) He has collected a large amount of information upon the value of iodine in the breeding and rearing of live stock, and describes methods whereby it may be fed to stock

A brief account of outstanding features of the Indian Science Congress held in January 1928 at Calcutta appeared in our issue of Mar 10, 1928, p 401 The *Proceedings* of the Congress have now been issued as a paper covered volume of 420 pages by the Asiatic Society of Bengal, 1 Park Street, Calcutta The volume contains the addresses of the president, Dr J L Simonsen, and the sectional presidents and abstracts of most of the papers presented There is a subject and author index

The Chemical Engineering Group of the Society of Chemical Industry has recently published vol 9 (1927) of its *Proceedings* It contains twelve papers dealing with various aspects of chemical engineering and covering a wide range Three of the papers are concerned with lubrication and lubricating oils and another discusses the oil pollution question at sea Thermo electric and resistance pyrometry in industry, the production of power from town's refuse, the importance of chemistry to the engineer, moulding machines for cast iron, fire extinguishers, the manufacture of fibrous cellulose, spray drying and the desiccation process of beet sugar manufacture, are considered in the remaining papers.

The usual bound volume, representing the Annual Report (for 1927) of the Smithsonian Institution, has recently been issued (Washington, D C Government Printing Office, 1 75 dollars) In addition to the formal report of the expeditions and other activities of the Institution, there is the customary appendix, occupying fully three quarters of the volume, which consists of brief accounts, by leading workers, of scientific discovery in particular directions Many of the articles are original, one, by Sir James Jeans, is a reprint of the supplement to our issue of Dec 4, 1926, entitled "Recent Developments of Cosmical Physics", others, again, are translations Such translations will be welcome to many scientific workers who are not at ease with a foreign language or do not see foreign periodicals regularly The present volume includes "The Centenary of Augustin Fresnel," by E M Antoniadi (from *L'Astronomie*), "Is the Earth Growing Old?" by Prof J F Pompeckj, and "The Origins of the Chinese Civilisations," by Henri Maspero (from *Annales de Géographie*)

Applications are invited for the following appointments, on or before the dates mentioned —A head of the department of civil engineering, architecture, and building, and a lecturer in metallurgy, each at the Bradford Technical College—The Principal, Technical College, Bradford (Feb 23) A junior scientific officer in the Admiralty Scientific Pool—The Secretary of the Admiralty (C E. Branch), Whitehall, S W.1 (Feb 23) A secretary (male) of the City of London School—The Town Clerk, Guildhall, London, E C 2 (Feb 25) A full time lecturer and demonstrator in anatomy at the University College of South Wales and Monmouthshire—The Registrar, University College, Cardiff (Feb 28) A lecturer in mining engineering at Armstrong College—The Registrar, Armstrong College, Newcastle-upon Tyne (Mar 2) A Lady Carlisle research fellow for research in classics, mathematics, philosophy, history, economics, or natural science, and a research fellow in some branch of chemistry or biology, each at Somerville College, Oxford—The Secretary, Somerville College, Oxford (Mar 6) A professor of mechanical engineering at the Heriot Watt College, Edinburgh—The Principal, Heriot Watt College, Edinburgh (Mar 16) A chemist in the Main Drainage Department, Public Works Ministry, Egyptian Government—The Director General, Main Drainage Department, Public Works Ministry, Cairo, Egypt (April 30) A full time teacher in electrical engineering at the Barnsley Mining and Technical College—The Principal, Harvey Institute, Barnsley A junior assistant (male) under the Directorate of Ballistics Research, Research Department, Woolwich—The Chief Superintendent, Research Department, Woolwich, S E 18

Our Astronomical Column

The Sunspot Cycle —Mr H W Newton gave a short address on this subject at the January meeting of the British Astronomical Association The average daily number of spots reached a maximum in 1928, but as regards areas, the curve of activity has two peaks, one in 1926 and one in 1928, with a slight depression in 1927 The average latitude of spots, which was 14° in 1928, was considered as an indication that the maximum is now past Ten spot groups were visible to the naked eye during 1928

Mr W M H Greaves spoke on the correlation of spots and magnetic storms the close resemblance between the spot curve and the curves of diurnal variations has long been known, but the research in which he has been engaged deals with the connexion between particular spot groups and magnetic storms Spots on the limb appear to have little influence, but a large number of storms can be associated with particular spots near the central meridian, or with active regions where spots had recently been present

Possible Return of Denning's Periodical Comet of 1894 —The new comet discovered by photography at Bergedorf on Jan 17 last has been observed also at the Yerkes Observatory on Jan 4 and 12, and a preliminary computation of the orbit leads to the inference that it may be a return of Denning's comet of 1894 The latter comet was observed for a short period only and its periodic time was deduced as 7 42 years. The small comet now visible gives undoubted evidence of being periodical and one of the Jovian group, with a time of revolution approximately 6 83 years or 6 years and 249 days Quite possibly planetary perturbations may have altered the period in the interim of thirty-five years since 1894 In any case, the comet appears to have eluded rediscovery at four returns to perihelion, namely, in 1901, 1908, 1915, and 1922—but several of these occurred at very unfavourable times, when the comet was unsuitably placed

It is now stated to be of the eleventh magnitude, and to be slowly declining in brightness, but it has not passed its perihelion Only large telescopes can deal with it effectively, but photographic means will be employed to follow the object for some time yet

Drawings of the Milky Way —Two beautiful delineations of the Milky Way have just been published Mr Easton contributes to *Mon Not R A S* for December two charts of the northern Milky Way which were photographically reduced from hand drawings, these in turn were made from a careful study of all the available photographs, the latest addition to these being the volume of Prof Barnard's plates, edited by E B Frost and M J Calvert The charts are reproduced in negative, and the contrast has purposely been somewhat exaggerated in order to facilitate detection of structure A system of faint curved streamers extending to the Pleiades is of special interest

The other work is a study of the southern Milky Way, by A Pannekoek (*Annals of Lembang Observatory*, Java, Vol 2, Part I) His work was entirely visual, the brightness of different regions being compared by Argelander's step method The reproduction is in negative, and is on a larger scale than Mr Easton's, there are three charts, each covering 60° of galactic longitude, and key charts with reference numbers, which serve as a guide to the measures of brightness of the different regions that are given in the Introduction The work also contains a few photometric measures of the Gegenschein and the greater Magellanic cloud

Research Items.

PRE-PALÆOLITHIC IMPLEMENTS.—In vol 5, pt 3, of the *Proceedings of the Prehistoric Society of East Anglia*, Mr J Reid Moir has some further remarks on the archæological contents of the Forest Bed at Cromer In 1926 and 1927 he again examined the remarkable spreads of flints exposed at low tide at Cromer, East and West Runton, and at Sheringham It was noted that the flints differ in character at the different sites On the Cromer site were found a number of black unchanged flints, obviously not due to human action, but among these are a number of flakes which do show a clearly defined bulb of percussion These are due to the action of visitors and children searching for shell fish, when either they are broken as slabs of rock are turned over or dropped to make them break Although the fortuitously made bulb can generally be distinguished from the type of bulb shown by the ochreous specimen, there are some which are comparable It is thought that these may be explained by an incomplete detachment in flaking which has afterwards jarred off It is pointed out that no ochreous specimens occurred among the spreads of flint uncovered by the great storms of 1927–28 and bulbous flakes were conspicuous by their absence. It is also pointed out that some of the ochreous flints collected in 1927 bear evidence of glacial action in the form of striations on their flaked surfaces It may not be out of place to direct attention in this connexion to some remarks by Mr C E Vulliamy on the subject of tertiary man in *Man* for January He points out that the rostro carinate is one of the commonest forms produced by natural agency, and further, that while the flints attributed to human agency agree in size with the naturally shaped flints on their respective sites, prehistoric man must have gone to an immense trouble to produce an implement not too well adapted to his needs when there were innumerable natural forms ready to hand which would have served his purpose as well or better

PREHISTORIC POTTERY AT MALTA.—The archæological section of the annual report of the working of the Museum Department, Malta, during 1927–28, contains several items of interest which are worthy of more than passing mention Curiously enough, however, one of the most interesting observations arises out of the investigation of modern and not prehistoric material In July 1927, during the levelling of ground outside the Porta Reale, Valletta, a number of potsherds were unearthed These were fragments of household ware, mostly Sicilian, of the beginning of the seventeenth century Among them were a number of fragments of large vessels, amphoræ jars, basins, bottles, etc, with thick walls and smooth outside surface This ware was covered with a red slip on which elaborate designs in white line had been painted with a brush, but in some cases the slip was white and the lines red This ware is North African rather than Sicilian, and was in common use in Tunis and Algeria in the seventeenth century It is common on old sites in Malta and Gozo, in one case at least on a site corresponding to a Roman horizon Dr Gobert, who is studying this ware in Tunis, considers that it is a survival of a prehistoric industry At Tarxien, which produced a number of smaller antiquities during the year, some interesting potsherds were found, of which one is of extreme importance This is a fragment of a reddish grey colour of a fine paste free from grit, the surface being smooth and hand polished It is part of a plate exquisitely decorated with incised lines which are filled with red pigment A border is composed of chevrons with a dot in the centre, and representations of trees and bulls are shown Two profiles of bulls are preserved, one giving the horned head and shoulders, the other the body without the head It is said to be the most beautiful piece of ware found at Tarxien, or indeed anywhere in Malta

FREEMARTIN AND A FREEMARTIN-LIKE CONDITION IN SHEEP.—Mr J A Fraser Roberts and Dr A W Greenwood (*Jour Anat*, vol 63, pt 1, 1928) describe an undoubted bovine freemartin of extreme type in which the modification in the male direction was more pronounced than in any previously described case The animal possessed a penis, traversed by a urethra which terminated in a vulva There was no trace of a scrotum In the second case the authors describe a freemartin-like condition in a sheep twin This is specially interesting in view of the doubt which has been expressed as to the existence of the freemartin condition in sheep The lamb described was a twin, but the sex of the other twin is unknown The anatomy of the lamb was extremely similar to that of typical bovine freemartins, and the authors conclude that it was a freemartin of the bovine type They suggest that a comparison of the bovine freemartin and developmental mammalian intersexes provides evidence for the view that the latter are genetic males and suggests possible criteria for a recognition of the genetic sex of mammalian intersexes Even in the most extreme freemartin cases where the internal genitalia are almost completely male, there is no suggestion of the formation of scrotum or of prepuce where the penis of the male ends This points to the fact that these structures do not develop in the genetic female There is therefore good reason to suppose that a range of individuals that include cases showing these structures are genetic males

GROWTH AND SEX IN THE LIMPET.—Dr J H Orton (*Jour Marine Biol Assoc*, November 1928) records observations which lead to the following conclusions that *Patella vulgata* is not an ordinary diœcious species, that most, if not all, individuals are male at the first sexual maturity, that change of sex from male to female may occur at the age of one year and at any time afterwards, and that the occurrence of old males indicates the possibility of the existence of two kinds of males, one pure and one protandric Spawning at Plymouth may extend from August to March in different seasons with a maximum about January to February The conditions controlling breeding and spawning are unknown Many limpets settled and grew on the cement piles of a new wharf constructed at Plymouth, hence the maximum age of these limpets was known It was found that at an age of about one year, limpets grew to lengths of 26 35 mm in 1912 and to at least 11-27 mm in 1913, and at an age of two years to at least 53 mm in 1911 13, and to 47-49 mm in 1912-14 The shells were of the mid tide level type and were low, broad, and rather thin It is considered that such growth in length is unusual and is correlated with the habitat and favourable climatic conditions Seasonal shell growth is briefly discussed, a post-breeding shell growing period is general in spring and early summer, but it is not known whether a mid-summer resting period is general among individuals more than one year old Investigations into the cause of variation in shell-height indicate that height is determined probably entirely by the degree of exposure of limpets to desiccation—the drier the habitat the higher is the shell Limpets submerged at neap tides have a relatively uniform low shell, those exposed at high-water neaps have a relatively high shell, which is

higher in the drier than in the damper situations, apparently irrespective of exposure to wave-action

LOBSTER CULTURE —*Naturen*, No 10, for October 1928 contains an interesting popular survey by Mr Alf Dannevig of the history of lobster culture and of his experiments on rearing lobsters in Norway His account of the experiments has already been noticed in our columns (Aug 18, 1928, p 253) In the present paper the growth of the lobster fisheries is traced from the beginning of the seventeenth century to our own times Clear diagrams showing various statistics and figures of the larval stages as far as the fourth or 'lobsterling' stage are given, and photographs and figures of the experimental apparatus In 1928 upwards of fifty thousand young were reared to the lobsterling stage, representing 34 per cent of the larvæ used for the experiments

VITICULTURE SCION AND STOCK INFLUENCE —Whilst viticulturists will find much valuable information in the 'Memorandum upon Viticultural Research," by D Akenhead, published as E M B 11, by the Empire Marketing Board, November 1928, horticultural investigators in general will find in it a very temperate analysis, with full citations of the literature of the conflicting statements as to the influence of scion and stock upon one another in vine culture The introduction of the *Phylloxera* to Europe, upon American vines imported because of their resistance to *Oidium* —when an insect that had seemed to be a relatively harmless leaf parasite developed as a scourge of the root system upon the old established European varieties, at least in the southern part of their range—made the practice of grafting susceptible and valuable European varieties upon resistant American root stocks the immediate step to take to preserve the viticultural industry in southern Europe Graft propagation then developed very rapidly, and upon a scale which rendered the provision of suitable root stock material a problem of great difficulty The result has been an interminable controversy as to the effect of the introduced root stock upon the yield of well known vine varieties, both in quantity and quality, and upon the length of life of the old established varieties in the plantation This report gives very concise data as to the conclusions reached by experienced nurserymen of the chief vine growing countries in Europe, and by experimental stations both in the United States and Switzerland The influence of scion upon root stock is less evident to the practical man, though equally important in practice in the end, and has received less attention but does receive consideration in observations upon strains relatively resistant to lime chlorosis

THE INSECT CATCHING MECHANISM OF THE BLADDERWORT —Dr Alexander Skutch has performed a valuable service for botanists in bringing together, in the *New Phytologist*, 27, 261 297, December 1928, the literature dealing with this interesting problem It will be news to most botanists that in four different countries, different observers independently, within the space of fifteen years, recorded observations which give a direct clue to the method by which the insects are trapped It now appears that the entrance of the insect is associated with a sudden change in volume of the bladder, which must be regarded as under tension, as a result of its method of growth, and the opening of the valve, itself still a matter of difficulty to understand, is accompanied by a rapid inrush of water which carries the insect with it Some delay in observing the phenomenon is probably due to the fact that if the plant is taken out of water, most of the taut bladders 'spring' with an entry of air into the bladder When this plant is observed afterwards, no further trapping of insects is likely to be seen upon it for some time The conditions determining the entry of water into the closed bladder are an interesting subject of investigation It appears that the closed bladder is sealed osmotically, the whole bladder being covered with a cuticle that behaves as a semi permeable membrane As a result it is very difficult to plasmolyse the cells of the bladder by immersing it whole in strong concentrations of inert substances, as the cells are able to withdraw more water from the liquid in the bladder It also remains a problem to what extent the entrapped insects are killed and digested by the fluid of the bladder or the peculiar hairs lining the inner walls Green organisms, such as *Euglena*, have been seen to live and multiply within the bladder, on the other hand, colourless organisms like *Paramœcium* seem to die more rapidly than under normal conditions

GOLGI BODIES IN THE HIGHER FUNGI —Prof S R Bose, of Calcutta, writes to NATURE that, in view of Prof Gatenby s letter in the issue of Dec 3, 1927, he has re examined the higher fungi, using Bowen s method He then finds that Bowen s osmiophilic platelets are nothing but mitosomes, and (the bigger ones) the discoplasts of Dangeard These are the mitochondria greatly changed by swelling and vesiculation due to the action of the osmic acid in the fixative As Guillermond has recently pointed out (*C R Soc Biol* 98, pp 368 371, Feb 1928), osmic acid so satisfactory a fixative with animal cells, is very irregular in its action on the cells of higher plants Prof Bose finds that in the basidia of the higher fungi, no rod shaped structures are seen, but only a number of round vesicular bodies These are metachromatic corpuscles within the vacuoles of the basidia They appear in almost the same position in the basidia on vital staining with neutral red Prof Bose directs attention to the fact that Dr D R Bhattachargee, working on vertebrates at Allahabad has concluded that the Golgi bodies and vacuoles (vacuome) are homologous structures (*Allahabad University Studies*, 1927 28) Dr Viswa Nath, of the Punjab University, has also stated (in *Q J M S*, October 1928) that "the solid granular Golgi elements are artifacts produced by the excessive precipitation of metallic silver or osmium inside the vacuoles "

FLOODING OF THE DANUBE —In a study of recorded Danube floods in an article in *Matériaux pour l étude des calamités* for July–September 1928, L Brandl shows that specially calamitous floods occurred four times during the nineteenth century once in the eighteenth century, and at longer intervals in most previous centuries Allowance must be made, however for the incompleteness of earlier records and the liability of flooding to be less noteworthy when population was less dense along the river The natural causes of the floods are shown to be twofold, the formation of ice barriers and excessive rainfall Ice barriers were more frequent in past times before the river was regulated and its channels deepened Then there is a record in the fourteenth century of an ice barrier near Vienna which lasted seventeen weeks and caused the river level to rise six to eight metres An ice barrier below Bratislava in 1922–23 affected the level of the river many miles higher up Protective and preventive works include the reinforcement of the river banks and the construction of dikes such as the one that protects Vienna

INTRUSIONS OF SOUTH EASTERN ICELAND —In the *Quart Jour Geol Soc*, pp 505 535; 1928, a detailed description is given of the main plutonic intrusions

of south-eastern Iceland by Miss H K Cargill, Dr Leonard Hawkes, and Miss J A Ledeboer The intrusions are found to be replacive stocks with steep sides and domed roofs, and no visible floor Many are composite, being composed of gabbro with granite and/or granophyre, the biggest, however, Slaufrudal, is of granite rock alone Where the outcrops are elongate in plan, the longitudinal direction coincides with the strike of the regional dykes The suite of rocks is similar to that common elsewhere in the Brito Icelandic or Thulean Province Intermediate types are unimportant The authors record a 'diorite,' but its description suggests that it is intermediate as a result of mixture of two magmas rather than as a consequence of differentiation It is deduced from other evidence that two magmas, basic and acid, co existed, but the extreme magmas are inter preted as products of differentiation which operated continuously throughout the history of the igneous cycle No process which could produce such magmas is suggested Intrusion of acid magma beneath Iceland is regarded as having saved Iceland from the general collapse of the North Atlantic plateau which occurred during the latter half of the Tertiary period

Indian Rainfall —The Indian Meteorological Department has completed an important work on Indian rainfall It is a summary of Indian rainfall for the fifty years 1875–1924, and constitutes the second part of the twenty fifth volume of the *Memoirs* of that Department The preface gives a brief history of rainfall measurement in India and explains how the present work, which was begun by Sir Gilbert Walker in 1913, was made possible by Sir John Eliot's introduction many years ago of a uniform system of measurement involving the use of gauges of standard pattern, tested before issue by the Depart ment The most important part of the undertaking was the construction of a table showing the rainfall for each of the many divisions and sub divisions into which the country has been divided for climatological purposes, expressed as a percentage of 'normals' based on records obtained up to the end of 1910 As a method of arriving at an understanding of the causes of the variations whether 'casual or periodic, in the rainfall of India, an undertaking of this kind—involving the isolation of one meteorological element from the many others to which it is related—is of small value in proportion to the labour involved It is rather in studies of the influence of that rainfall on the growth of crops and on public health, and as an aid in planning schemes of irrigation, that its real value must be sought, for these purposes the volume is well adapted, and inquirers should have no difficulty in obtaining in a minimum of time informa tion that has been gained by the labours of many workers throughout two generations

Ionisation by Collision – Many of the sources of uncertainty in quantitative measurements of ionisa tion by electronic impact are avoided by a device described by A v Hippel in a recent issue (No 24) of the *Annalen der Physik* Instead of passing into stationary gas, the electrons are shot at right angles through a beam of atomic particles which is issuing from a reservoir at the appropriate high temperature into a highly evacuated space The products of ionisation pass on with the still unionised components of the beam, and are analysed in a receiving chamber by a mass spectrograph, or by a simple electrical system So far the method has been tried only with a beam of mercury atoms, and the results obtained are not in complete accord with those obtained by other methods which had previously been accepted as substantially accurate, but the use of atomic rays instead of gas or vapour should make it possible to study in a relatively straightforward way a consider able number of refractory substances which would otherwise be very difficult to investigate

Counting Scintillations —During the course of an investigation of the various factors involved in the counting of α particles by the method of scintilla tions, which is described in the January issue of the *Proceedings of the Royal Society*, J Chariton and C A Lea have obtained some results of great interest in connexion with the mechanism of the human retina Considered as a detecting instrument, it has long been recognised that the eye is extremely sensitive, but the figures now given are very striking It appears that, in the most favourable circumstances, a skilled observer requires only some twelve quanta of green light, with a total energy of about 5×10^{-11} erg, to excite the sensation of vision The optimum conditions for reception occur when the flashes follow one another regularly, and so can be directed to that part of the retina which is most sensitive the passage of the nerve impulses to the brain should also have been facilitated by previous abstention from food, or treatment with a tonic drug such as strychnine, whilst the area stimulated should be small, possibly not more than a single retinal element The duration of the flash is immaterial, so long as it is spread over a period of less than about a hundredth of a second Another important point discussed is that of the nature of the feeble scintillations sometimes produced by β rays, it has been shown that each flash corre sponds to the simultaneous incidence of several β particles on one of the small phosphorescent crys tals in sharp contrast to the scintillations due to α rays, where in the majority of cases of practical interest each flash registers the impact of a single α particle

A New Colorimeter —Part 5 of volume 29 of the *Transactions of the Optical Society* contains a descrip tion of the new colorimeter devised by Mr W D Wright in order to carry out some researches on colour vision for the Medical Research Council, and in particular to determine for a large number of observers the locus of the spectral colours in the colour triangle The new instrument utilises three of the spectral colours as the three primaries of the triangle They are combined by reflecting prisms placed in the spectrum, which return the three colours along their paths of incidence to a reflecting prism which deflects them out of that path to the photo meter, where they fill half the field The other half is occupied by the colour to be matched, which is also obtained from the spectrum Variations of intensity of the light of any colour is produced by the introduc tion of a neutral tinted gelatine wedge which may, if found too variable, be replaced by a black glass wedge The instrument in its present form occupies a considerable space, but it could be simplified and reduced in size if required for industrial purposes

Vitamin B —It has been suggested by Jansen and Donath that vitamin B is a glyoxaline derivative, and Y Sahashi has commenced the preparation of a series of glyoxaline derivatives in order to study their effect upon the polyneuritis of pigeons The first compound to be prepared was 4 (or 5) glyoxaline ethyl methyl-carbinol, which brings about a temporary cure of polyneuritis and in this respect resembles 2 6-dioxy-quinoline After 7 10 days, however, the pigeons in-variably died This work is described in the December issue of the *Abstracts of The Bulletin of the Institute of Physical and Chemical Research, Tokyo*

Remarkable Clouds at High Altitudes.

By Prof CARL STØRMER.

BETWEEN 1871 and 1892 some very remarkable clouds were seen both in England[1] and in Norway These clouds, which before dawn or after sunset were characterised by their brilliant prismatic colours, were especially studied by the late Prof H Mohn[2] Visual observations in England in 1885, and by Prof Mohn in 1892, made it very probable that their altitude was exceptionally great, but no certain conclusion could be drawn from these visual observations

I saw these clouds in the year 1890 and made very careful observations of their forms and colours, but after 1892 I did not see them at all in spite of a very careful watch It was not until Dec 27, 1926, that I saw them again That afternoon I was unable to determine their height, but some days later, on Dec 30, I succeeded in taking two pairs of simultaneous photographs of them from my two aurora stations, Bygdö and Oscarsborg The measurement and calculation of these photographs gave heights between 26 km. and 30 km above the earth[3]

FIG 1 —Nacreous clouds to the west seen from Oslo

On Jan 13 of this year the clouds were again seen, both in the early morning and in the evening I was fortunate enough to have my two stations, Oslo and Oscarsborg, in action immediately after sunset, and a long series of more than ninety simultaneous photographs were taken from both stations These give unique material for determining the exact height and situation of these remarkable clouds

FIG 2 —Photograph taken from Oslo

I myself conducted the photographic work from the astronomical observatory, and simultaneous photographs were taken in Oscarsborg by my assistant Hafnor by orders over the telephone My assistant in Oslo was Tveter

The best photographs were taken so late that the stars were visible, which allowed us to measure and calculate the height and situation of the clouds in the same manner as I have done in the case of the aurora borealis[4] In fact, the clouds remained luminous until three hours after sunset.

[1] See NATURE, vol. 32, pp 220 and 486

[2] Perlemorskyer, *Christiania Videnskabsselskabs Forhandlinger* for 1893, and 'Irisierende Wolken,' *Meteorologische Zeitschrift*, March 1893

[3] Photogrammetrische Bestimmung der Höhe von irisierende Wolken (Perlmutterwolken) am 30 Dec 1926 *Geofysiske Publikasjoner*, vol 5, No. 3 Oslo, 1926.

[4] *Geofysiske Publikationer*, vol. 1 No. 5. Oslo

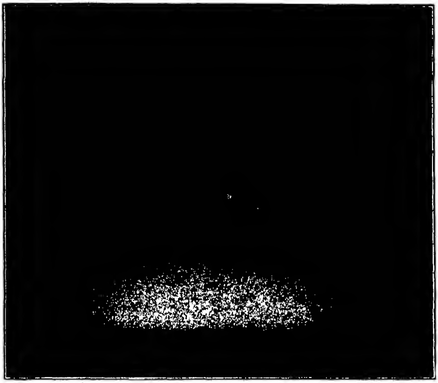

Fig 3—Photograph taken simultaneously with the preceding one (Fig 2), from Oscarsborg

Fig 1 is from a photograph taken from Oslo just after sunset, through a red filter on panchromatic plates The most luminous parts shone in beautiful colours like mother of pearl

One of the best pairs of simultaneous photographs was taken at 16 h 40 m 30 s G M T to the west Fig 2 and Fig 3 are reproductions of the photographs taken from Oslo and Oscarsborg The colours had then disappeared, but the clouds were still visible among the stars In the photographs the star Atair is seen near the centre, ζ Aquilæ to the right, and the constellation Delphinus up to the left

Along the outlines of the clouds we have chosen fourteen points, the positions of which are seen on the diagram Fig 4

As the distance separating the aurora stations is about 27 km., the parallax was great, which gave a very trustworthy determination of height

The result was as follows

Point.	Height.	Point.	Height.
1	25 3 km	8	24 3 km
2	25 6 ,,	9	23 4 ,,
3	26 1 ,,	10	24 5 ,,
4	25 1 ,,	11	23 1 ,,
5	24 8 ,,	12	23 0 ,,
6	22 4 ,,	13	23 9 ,,
7	24 3 ,,	14	22 3 ,,

Thus we have the same order of altitude as the clouds photographed on Dec 30, 1926

As Prof Mohn had already found, these remarkable clouds are associated with an atmospheric depression to the north of Oslo, giving typical Föhn from the mountains in the west and north with high temperature and clear weather In this way it has been possible to have a view upwards through a cyclone in that part which is generally obscured by clouds and rain It may be possible that the iridescent or nacreous clouds are much more common over the ascending part of a cyclone, but that they are in general invisible, except in the case where a Föhn makes that part transparent so that the nacreous clouds can be seen

The preparation of the whole material obtained may give a good deal more information about these remarkable clouds

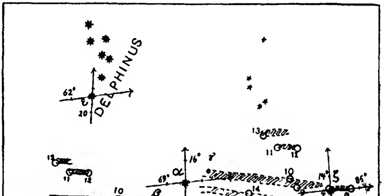

Fig 4—The clouds as seen from Oslo are shown by complete lines and as seen from Oscarsborg by dotted lines, corresponding points have the same number For each star two directions are marked The vertical circle and the great circle through the star and the point K where the direction Oslo to Oscarsborg meets the sky (direction of parallax) On these directions are marked the height above the horizon and the angle between the direction of the star and of the point K.

New and Old Views in Prehistory[1]

IN her presidential address, recently delivered to the Prehistoric Society of East Anglia, Miss D A E Garrod reviewed the present position of research in prehistory

Now that research is spreading far beyond the confines of western Europe, it is clear that the classic sequence of culture periods, from the Chellean to the Magdalenian, cannot be applied to all regions in its entirety Mortillet's classification represented the sequence in time of a certain number of palæolithic cultures, seen, as it were, in section over a very limited area of the earth's surface, but that classification records only the order of arrival in the west of a series of cultures, each of which has originated, and probably passed through, the greater part of its existence elsewhere The time to find a new classification appears to have come

An attempt is made to restate the evidence in a chart (Fig 1) showing the relations of the palæolithic cultures of Europe The Upper Palæolithic is divided into two branches—the Capsian and the Aurignacian—here regarded as separate offshoots from a common stock at present unknown This view is at variance with that hitherto accepted, but it is suspected that the centre of dispersal of the Upper Palæolithic cultures may have been in Asia rather than in Africa Evidence from the Caucasus, from Syria and from Palestine, points to an Aurignacio-Mousterian industry, though its association with the Galilee skull classifies the culture of the Zuttiyeh Cave as Mousterian despite its mixed character The contact of Mousterian and Aurignacian in Palestine is, evidently from the characteristics of both, earlier than that of Abri Audi It is tentatively suggested that in Palestine the centre of dispersal is not far off and that the evidence is slightly in favour of the French Aurignacian being derived from the East rather than North Africa As regards the Solutrean of the West, the evidence points to it being merely an influence from the Solutrean people of the Hungarian plains, at present of unknown origin

While one branch of the Aurignacian or European Upper Palæolithic stem fused with the Solutrean from Central Europe, the other branch developed into the Magdalenian, the one truly indigenous palæolithic culture of the West, which later became the prevailing culture in France and the Cantabric region, and spread in an impoverished form into Central Europe and into Belgium and England

The pre Capsian industry of the Manzanares Gravels, and of the Low Terrace of Moutiers of the Somme Valley—"Warm Mousterian"—show that the precursor of the Upper Palæolithic had already come into being while the Acheulean was still the dominant industry of the West The Mousterian, Breuil holds, is the result of a fusion of three elements, the Acheulean, the Levallois flake, and the pre-Mousterian flake industry of Central Europe of the Riss Würm interglacial deposits at Ehringsdorf, Taubach, and Krapina As Chellean and Acheulean are not found in Central Europe, this pre Mousterian must take their place and go back to the first interglacial Presumably the Heidelberg jaw belongs to an early phase of this It is possible that the culture of High Lodge, Mildenhall, which presumably belongs to a Riss Würm interglacial, the estuarine culture of Clacton and the Swanscombe deposits may be derived from the Central European culture According to Breuil, the second element of the Mousterian proper, the Levallois flake, persisted throughout the Riss-Würm inter glaciation until it coalesced with the

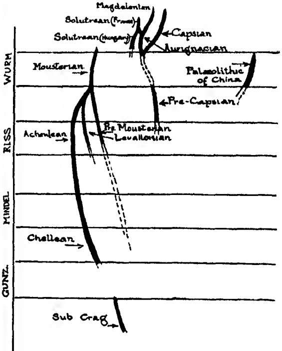

FIG 1

Acheulean in the Combe Capelle industry at the beginning of the last glaciation It is impossible at present to trace further back these contributory industries, except the Acheulean, but there can be no doubt that it develops without a break from the Chellean, at present of unsolved origin

The recently discovered palæolithic culture of China, combining the characters of the Upper and Middle Palæolithic, but not typical of either, may be explained if, the centre of dispersion being Central Asia, it is regarded as related to the West by descent from a common stock

The chart is purely tentative and intended to stimulate investigation in those great regions where prehistory is as yet unknown

[1] To be published in full in *Proc. Prehist. Soc. East Anglia*, vol 5, pt. 3.

Mechanism of Twinning in Metals

ARTIFICIAL or mechanical twinning may be regarded as the result of a movement within a crystal by which the orientation of the atoms, in a band bounded by parallel planes, becomes a mirror image, with respect to these planes, of the orientation of the atoms in the unchanged matrix on either side If such a twin band is to result from a mechanical impulse, for example, from an impulsive shear tending to depress the matrix on one side of the band with respect to that on the other, this relative movement of the material on either side of the planes bounding the twin band must be accompanied by a uniformly graduated or 'wheeling' movement of the atoms within the bounding planes

The problem is to examine for a given lattice the different ways in which a movement of this kind may occur, and to decide which of them is likely to be produced most easily The mechanism of twinning in the body centred cubic lattice forms the subject of Part I of a paper recently published (The Mode of Formation of Neumann Bands by S W J Smith A A Lee and J Young *Proc Roy Soc* A vol 121 No A788 Dec 3) If a wheeling movement of the atoms within the bounding planes is to take place in such a way that the twin relationship between the band and the matrix is to be produced the line in which the plane containing the wheeling atoms meets the twinning plane must be an axis of symmetry for the atomic distribution in the plane The angular wheeling movement during twinning is determined by the angle between the twin plane and the atom or wheeling plane The larger the acute angle between the possible twin plane and the possible atom plane the smaller is the angular movement required to produce the twin orientation of the band with respect to the matrix

Examination of the conditions of twinning in the body centred cubic lattice shows that the form of twinning most likely to occur is that of the type in which the twinning plane is $\bar{1}12$ and the atom plane is $1\bar{1}2$ By symmetry the same type of twinning will occur with $1\bar{1}2$ as twin plane and $\bar{1}12$ as atom plane During the transition from the initial configuration to the twin configuration the movement of the atoms produces a temporary increase in the width of the band of the matrix in which the twinning occurs Half way through the twinning movement the openness of the structure is at its maximum and the atoms lie midway between two forms of the body centred configuration In this position the slightest bias forward or backward will tend to make the system move under the operation of interatomic forces alone forward towards the twin lattice or backwards towards the original one

The markings produced in iron by shock were discovered by Neumann in 1850 and since then a number of investigators have studied the nature and mode of formation of these bands In Part II of their paper referred to above S W J Smith A A Lee and J Young furnish indisputable evidence that the bands are twins By X ray analysis it was found that the hexahedral meteorite (Coahuila) with which most of the experiments were made has a body centred lattice similar to that of the constituent—kamacite—to which the Neumann bands in octahedral meteorites are confined The orientation of the cubic lattice of a meteorite having been determined the geometrical relationship between the bands and the matrix was found by measuring the direction of the bands on polished and etched sections parallel to various faces In the meteorites examined the Neumann bands were found to lie on {112} planes

Direct evidence that the material within the bands is in twin orientation with respect to the matrix was obtained by examination of the figures produced by etching with copper ammonium chloride This etchant in dilute solution produced very beautiful flat bottomed etching figures (negative crystals) bounded by rhombic dodecahedral planes whereas dilute nitric acid produced long ridges and troughs with {100} planes on their sides The simplest way of deciding whether the twin relationship exists between the orientation of a band and that in the adjacent matrix is to make a section of the material perpendicular to the {112} plane, to which the band is parallel, and to compare the pits produced simultaneously on band and matrix In such a case the twin relationship is demonstrated by the fact that the etch pits in the band are mirror images of those in the matrix

Some difficulty was experienced in photographing the pits because of the different focus required to show the symmetrical contour and the facets but despite this difficulty some very conclusive photographs at high magnification (× 1680) were obtained by selecting an intermediate focus Etch pits in a number of bands and in the adjacent matrix were examined and photographed and by this means the twin relationship was established The movement involved in the formation of Neumann bands was determined from the displacement produced when the track of one band was crossed by another formed at a later time

University and Educational Intelligence

Cambridge —The prize of £30 from the Gordon Wigan income for physics and chemistry for a research in chemistry has been awarded to J G A Griffiths of Emmanuel College for an investigation on the photochemical decomposition of glyoxal

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Two noteworthy contributions to the subject of medical education have recently been published One was the eleventh series of Methods and Problems of Medical Education issued by the Rockefeller Foundation N Y dealing for the most part with special departments (eye nose children etc) of hospitals and universities in the United States and Europe their construction and organisation The second was a special Supplement to the *Lancet* (Jan 5) containing a review on medical education in the United States and Canada by the editor Sir Squire Sprigge He makes no attempt to formulate conclusions but directs attention to two fundamental divergencies worthy of further inquiry In Great Britain the tendency is to divorce the hospital from the university and to regard the former only as an adjunct to university education but in America and Canada the medical school is an integral part of the university which controls the teaching given in the hospital

In the Departments of Textile Industries and Colour Chemistry and Dyeing of the University of Leeds the progress of research work has been stimulated by a recent grant of £3000 a year for four years by the Clothworkers Company of the City of London enabling the University to institute a lectureship in textile physics and two assistantships and eight fellowships and scholarships for graduate students With the same object in view the University has conceded to selected research workers attached to the laboratories at Torridon of the British Research Association for the Woollen and Worsted Industries the privilege of reading for higher degrees at the University These developments have quickly borne fruit the number of graduate workers in the Department of Textile Industries being nearly three times what it was last session There are also 80 per cent more full time students and 13 degree students as against 5 Several lines of research in this Department are says the Report for 1927 28 converging to give an interpretation of the molecular structure of wool These are physico chemical research on the gel structure of the wool fibre a survey of the elastic properties of a number of wools at various humidities and temperatures up to 100° C and investigations of the plasticity of wool and the dependence of rigidity on relative humidity

Calendar of Patent Records

February 16, 1807—A patent was granted to Charles, third Earl Stanhope, on Feb 16, 1807, for a construction of ship that would withstand submarine bombs and similar attacks Lord Stanhope was the friend of Robert Fulton, and was partly responsible for Fulton being called to England from France during the Napoleonic wars to demonstrate the possibilities of his submarine boat for war purposes

February 16, 1904—The 'stepney wheel,' the first successful solution to the puncture problem of the modern motor car, was invented by Thomas and Walter Davies, and patented by them on Feb 16, 1904 The name of the wheel was derived from the address of the inventors, Stepney Street, Llanelly

February 20, 1806—The first canal lift as a substitute for the ordinary lock was erected at Tardebigge, near Bromsgrove, on the Worcester and Birmingham Canal It was the invention of John Woodhouse and was patented by him on Feb 20, 1806 The lift consisted of a wooden tank 72 ft long, 8 ft wide, and 4½ ft deep, which was hung on a series of chains passing over cast-iron wheels 13 ft in diameter The tank weighed 64 tons when filled with water and was counterbalanced by masses of brickwork on timber platforms hanging from the other ends of the chains It is said that the lift could be raised or lowered by two men in three minutes The arrangement soon, however, fell into disuse and has since been replaced by a long flight of locks A few other such lifts were erected, but did not survive long, and the lift system did not become successful until hydraulic operation was introduced about 1870

February 22, 1904—The 'thermos flask' was introduced under the English patent of Reinhold Burger of Berlin, which was dated Feb 22, 1904 The invention consisted simply in the commercial adaptation of the heat insulated vessel employed for the first time some ten years earlier by Sir James Dewar in his scientific work on the liquefaction of gases, and the validity of the patent was challenged successfully in the Courts No German patent was granted, but a *gebrauchsmuster* for the design had been obtained in 1902

February 24, 1839—The first patent to mention sulphur in connexion with the treatment of india-rubber was that granted in the United States to Nathaniel Hayward for the "combining of sulphur with gum elastic either in solution or in substance," on Feb 24, 1839 The patent was applied for at the instigation of, and was afterwards assigned to, Charles Goodyear, who later on in the same year discovered the process of vulcanisation, though he did not obtain his patent for the invention until 1844, a few months after Thomas Hancock, who had been working in the same field, obtained an English patent

February 24, 1881—Among the early systems of electric traction for street railways was that known as the surface-contact system, in which studs arranged at intervals along the track were normally disconnected from the electric supply mains and were only brought into the circuit when in actual contact with the current collector on a tramcar The first patent for this system was granted to Profs Ayrton and Perry on Feb 24, 1881, two months before the first commercial electric tramway (using both running rails as conductors) was opened near Berlin The surface-contact system has been tried in various towns in Great Britain, but was never entirely satisfactory and has been superseded by the overhead system

Societies and Academies.

LONDON

Mineralogical Society, Jan 15—**A Holmes** and **H F Harwood**: The tholeiite dikes of the north of England These dikes, bounded on the north by the Acklington dike and on the south by the Cleveland dike, form an outlying part of the Mull swarm To the Salen, Brunton, and Talaidh types, already recognised in Mull, the authors add Cleveland and Acklington types, and anorthite bearing varieties of each Chemical and mineral analyses are presented, and from a comparative study of the evidence it is shown that there are many features in the series as a whole which are not in accordance with the theory of crystallisation differentiation—**A Russell** On the occurrence of gold at Hope's Nose, Torquay, Devonshire A detailed description of a remarkable occurrence of crystallised arborescent gold in calcite, in Middle Devonian limestone at Hope's Nose, where it was discovered by Prof W T Gordon in 1922 Specimens have since been obtained from five distinct veins The gold varies in colour from a bright rich gold to almost silver white, and has a silver content of only 1 89 8 41 per cent—**H E Buckley** Crystallography of some organic compounds Collected records of goniometric measurements on crystals of various organic compounds

Linnean Society, Jan 17—**G Enderlein** The Copeognatha of the Seychelles Particular attention was devoted to the booklice and allied insects in 1908, and forty seven species, belonging to twenty seven genera, were collected Six families are represented, and the scaly winged forms (Lepidopsocidæ) account for more than half the species The abundance of Copeognatha was a feature of insect life in the Seychelles They were collected mainly by sweeping and beating foliage in the native forests at 1000 2000 feet above sea level, but some were taken also among non endemic vegetation at lower levels Ethiopian elements seem to predominate, although many groups of Seychelles insects are largely Eastern in origin—**S Maulik** Chrysomelid Coleoptera of the subfamilies Eumolpinæ, Galerucinæ, and Halticinæ from the Seychelles and other islands of the western Indian Ocean There are sixteen species, fifteen being described as new, distributed among nine genera, four of which are new to science Twelve species were found only in the Seychelles, one in both the Seychelles and Aldabra, two in Aldabra only, and one in the Farquhar Group The material, as a whole, indicates an endemic element in the Seychelles fauna, with some Austro Malayan affinities, also certain forms which have probably been imported, while the relationships of the Aldabran species are with Madagascar and Africa—**A B Rendle** A remarkable West Australian subterranean orchid recently described by Dr R S Rogers The plant consists of an underground rootless rhizome in symbiotic relationship with a fungus which closely invests the decayed roots of *Melaleuca uncinata* R Br It lives about a foot below the surface of the ground The flowers are borne in a dense head surrounded by an involucre of bracts which grows apparently towards the surface The inflorescence, which suggests the capitulum of a Composite, reaches about three inches across It is placed by Dr Rogers in a new sub-tribe, to come next to Gastrodiinæ—**F. E Lloyd**: The resistance of the door of the *Utricularia* trap to water pressure The trap is not only self-setting, but also, if uninjured, remains permanently in the set condition, as the result of negative pressure of

water within it The maintenance of the negative pressure depends upon the efficiency of the door The upper surface of the threshold of the door has a peculiar epithelium of soft thick walled compact cells forming a smooth mosaic Across this the lower door edge glides outwardly in resuming its normal position after the trap is sprung But the outer two cell rows of this tissue grow out to form a membrane providing a sort of pocket in which the middle portion of the door edge rests, effectively closing the rift between the door edge and the edge of the threshold against which it rests

Optical Society, Jan 17 —**E F Fincham** The function of the lens capsule in the accommodation of the eye The form of the anterior surface of the lenses of freshly dead animals is determined by making photographic records of the image reflected from the surface. The results show that in primates the anterior surface of the lens assumes a somewhat conical form with an area of increased curvature in the centre, when the suspensions are severed The capsule of the primate lens has a zone of increased thickness surrounding a central thin area The anterior lens capsule of animals of an order lower than the primates is approximately uniform in thickness, and the removal of the capsule does not cause an appreciable change in the form of the lens The theory is formulated that accommodation consists of a relaxation of tension upon the lens by the contraction of the ciliary muscle as stated by Helmholtz This relaxation allows the capsule to press upon the lens substance and mould it into the accommodated form The unaccommodated lens substance is therefore in its unrestricted or natural form and not under compression as supposed in the Helmholtz theory —**D S Perfect** A double reflection level The level was designed to assist the initial levelling of a floating system and to enable observations to be made on the constancy of level over extended periods of time Its error may be determined by direct measurement and without reversal —**T Smith, J S Anderson**, and **L C Cordle** Photographs of reflection caustics Caustics formed by reflection at the surfaces of a photographic lens are described

EDINBURGH

Royal Society, Jan 21 —**R B Mooney** and **E B Ludlam** The thermal equilibrium between ethylene, iodine, and ethylene di iodide The pressure of ethylene in equilibrium with a mixture of solid iodine and solid ethylene di iodide was measured by means of a glass spring manometer Observations were made at temperatures between 10° C and 65° C The vapour pressure of undissociated ethylene di iodide was determined at four temperatures within the same range by the gas stream method —**E B Ludlam, H G Reid**, and **W B Soutar** The flame of chlorine burning in hydrogen The flame consists of a livid white inner cone ascribed to the re combination of dissociated chlorine atoms, and an outer blue zone which gives a band spectrum in the violet and near ultra violet This spectrum is provisionally regarded as due to the hydrogen chloride molecule (see NATURE, Jan 19, p 86) —**R W Armour** and **E B Ludlam** The photochemical equilibrium between hydrogen, bromine, and hydrogen bromide Light of very short wave length (185 $\mu\mu$) should have a slight effect in causing the formation of hydrogen bromide from its elements Using the aluminium spark as a source of light, at equilibrium the partial pressure of the hydrogen bromide is slightly less than 2 per cent that of the bromine The absorption coefficient of bromine has also been measured in the ultra violet region 254 $\mu\mu$ 185 $\mu\mu$ by means of a photo electric cell, bromine is less opaque in this region than was previously supposed —**W W Taylor** (1) The lyotrope effect and the antagonistic action of ions The lyotrope effect is well shown in the precipitation of ferric hydroxide sol by neutral salts, although the concentrations are very small No antagonistic action is shown by Li and Mg or by K and Ca, the effect is *additive* ClO_3' and SO_4'' show the opposite effect of *adjuvant* action which amounts to 50 per cent The opalescence temperature of a phenol water system is affected lyotropically by equivalent solutions of salts (both for cations and anions) The lyotrope effect seems to be an expression of the water binding power of the salt —(2) Demonstration of a new method of determining 'free' and 'bound' water The method follows from the above experiments on the effect of solutions on the opalescence temperatures of a phenol water system Opalescence temperatures are determined, and from these data the ratio of 'free' to bound water can be ascertained, the assumption being made that the 'free' water of the solution is alone effective in this respect —**W O Kermack, A G McKendrick**, and **E Ponder** The stability of suspensions (3) The velocities of sedimentation and of cataphoresis of suspensions in a viscous fluid A theoretical investigation confirmed by experiments on the sedimentation of red blood cells in the Goughian or spherical form In both sedimentation and cataphoresis the velocity of any particular particle is retarded as the result of the presence of the other particles, so that the velocity of a particle in a suspension is less than that of an isolated particle When a cloud of particles is subjected to cataphoresis, the rear boundary tends to be sharply defined and the front to become more and more diffuse The reason for this is that if an isolated particle happens by chance to lag behind the general swarm, its speed is accelerated, and so it tends to make up on the others, whereas if it happens to take up a position in advance of the general swarm the acceleration which it experiences carries it still farther ahead

PARIS

Academy of Sciences, Jan 14 —**L Lecornu** The Clapeyron cycle —**Maurice Fréchet** Probable convergence —**Mme M Piazzolla-Beloch** Surfaces of the third order possessing curves with linked branches —**S Rossinski** A class of couples of stratifiable rectilinear congruences —**Radu Badesco** A generalised Abel integral equation —**Srivastava** The singularities of a class of series of Dirichlet —**B Gagaeff** The unicity of a system of orthogonal functions invariant relatively to the differentiation —**Alex Froda** The maxima and minima of uniform functions of real variables —**Z Horak** The principles of a general theory of shock —**J Le Roux** A general property of the movement of a system of material points —**J Kampé de Fériet** The connexion between the absence of negative pressures and the sense of the concavity of the stream lines in the plane movement of an incompressible fluid round an obstacle —**E Baticle** The curving of grooved elliptical arches —**Mesnager** Remarks on the note of M Baticle —**H Mineur** The rotation of the galaxy A different result from those of Oort and of Plaskett is obtained, and the cause of this is discussed —**Mario Bossolasco** The ellipticity of the terrestrial equator —**A Guillet** The photographic registration of an angular velocity Application to ballistic measurements —**L Brillouin** The electronic theory of metals, according to Sommerfeld, and the mean free path of the electrons —**M Ponte** The diffraction of the electrons by crystalline powders Electronic analysis —**Marcel Cau** The

double refraction and dichroism of thin layers of iron obtained by distillation —**Jean Cabannes** The secondary radiations in the light diffused by quartz —**Maurice Lambrey** The ultra violet absorption spectrum of nitrogen peroxide —**Nathaniel Thon** The electromotive potential and electrokinetic potential of graphite —**M and Mme Lemarchand** The application of the law of mass action to double de compositions of salts —**H Swietoslawski** A new application of the differential ebullioscope The apparatus described in an earlier communication can be applied with advantage to distinguish between a pure substance and an azeotropic mixture **Mlle Germaine Marchal** The action of silica and alumina on sodium sulphate The decomposition of sodium sulphate at high temperatures up to 1300° C is accelerated by the addition of silica or alumina —**R Levaillant** Neutral isopropyl sulphate and normal propyl sulphate—**P Fallot** The structure of the sub Betic zone between Moratalla and the Betic zone —**Porchet** A method for the determination of the base of a subterranean sheet by observations of the variations of its free surface —**Mlle Panca Eftimiu** The karyo kinesis of *Spathularia flavida* **Edouard Papin** The vesico uteral reflex **Charles Pérez** Sexual differ ences in the ornamentation and in the pigmentary system in *Macropodia rostrata* —**Edouard Chatton Mme Marguerite Lwoff and André Lwoff** The prepalintomic and metapalintomic metamorphoses of the Fœttingeridæ (ciliated) **Mme Phisalix and F Pasteur** The action of the ultra violet rays on the virus of rabies and its rabic and poisonous antigens —**A Policard S Doubrow and D Pillet** Histochemical researches on pulmonary anthracosis Results obtained by the application of the method of microincineration to sections of lung tissue —**R Leriche and R Fontaine** The rôle of the left stellated ganglion in the determination of the crisis of angina pectoris

ROME

Royal National Academy of the Lincei Communica tions received during the vacation —**L Lombardi and P Lombardi** Measurement of the local dissipations of energy within a circumscribed part of the magnetic circuit (3) The method and apparatus previously de scribed are found to be applicable to the measurement with sufficient approximation of the losses of power in a circumscribed portion of the magnetic circuit even if these do not exceed a few watts provided that there are available an electro dynamometer of convenient sensitiveness a condenser affected by slight retarda tion of polarisation and a source of electromotive force approaching the sinusoid form or reactance capable of rendering the form of the magnetising current approxi mately sinusoid Failure of the last condition intro duces into the numerical interpretation of the measure ment an error which increases with the saturation not unlike that with which ordinary wattometric methods would be affected if the loss were referred to the maxi mum values of the induction in the absence of exact knowledge of the form factor of the tension applied —**T Boggio** Three dimensional space curves and Ricci s homograph —**Maria Pastori** Commutation formulæ in the derivation of tensors The existence is demon strated of a general commutation formula of covariant (or intrinsic) derivatives of higher order including as a particular case the known formula for the second derivatives **H Geppert** The adiabatic invariants of a differential generic system (2) —**W Slebodzinski** Deformations in a variety of constant curvature **G Sansone** Determination of the number of the con gruences $x^4 + ax + a = 0$ (mod p) having three roots with the same quadratic character modulus p —**J Kanitani** A geometrical interpretation of the linear projective element of the hypersurface —**B Finzi** Kutta Joukowski s theorem Signorini s recent de monstration of Kutta Joukowski's theorem does not remove the exceptional case pointed out by Cisotti, which is now shown to be subordinate to the conditions of regularity at the contour —**P Emanuelli** Non central total eclipses of the sun Of the nineteen eclipses of this type occurring between 1200 B C and A D 2100, five take place in the northern and fourteen in the southern regions eight at the beginning and eleven at the end of the second series In every case with the exception of that of 261 B C the non central total eclipse is either preceded by a central and fol lowed by a partial eclipse or preceded by a partial and followed by a central eclipse The conditions of the nineteen eclipses are discussed —**B Rossi** The dis tribution of electricity in conductors immersed in a homogeneous anisotropic medium It has been shown recently that the distribution of electricity on a con ducting ellipsoid immersed in an indefinite homogene ous anisotropic dielectric is independent of the dielec tric homograph of the medium and coincides with that exhibited when the dielectric is isotropic It is now found that the distribution of electricity on the surface of a conductor is not dependent on the dielectric homo graph of the medium (supposed homogeneous) only when the conductor itself has the form of an ellipsoid (or in particular a sphere) and when other conductors are absent from the field —**G Gentile and E Majorana** The separation of the Röntgen and optical terms owing to the spinning electron and the intensity of the cæsium lines Fermi s potential not only permits a good *a priori* determination of all the energy levels of heavy atoms but given the statistical character of this theory of the atom also allows of very exact calcu lation of the separation of the terms —**L Fernandes** Thio salts (7) Polythiovanadates The author s in vestigations on complex thio salts especially on thio aquates are extended to the products of the polymeri sation of the thiovanadates various ammonium guanidine and thallium salts are described — **A Ferrari and I A Inganni** The importance of the crystalline form in the formation of solid solutions (3) Thermal analysis of the anhydrous systems $MnCl_2$ $CoCl_2$ $CdCl_2$ $CoCl_2$ and $MgCl_2$ $CoCl_2$ These three systems exhibit miscibility in the solid state in all proportions of the components The curves showing the tempera tures at which solidification begins present neither maxima nor minima **E Onorato** The sulphur de posit of Monte Solforoso near Scrofano in the province of Rome **Enrico Clerici** Applicability of isopykno meric analysis to auriferous rocks Observations made on auriferous rocks of various origins show that the presence of native gold even in as small a propor tion as 0 5 gram per ton may be rapidly detected by means of isopyknomeric analysis **M Comel** Analy sis of the oxygen absorption curve of muscle pulp as a function of the hydrogen ion concentration Further investigations on the gaseous metabolism of frog muscle pulp in equilibrating phosphate solutions yield an oxygen absorption curve indicating three zones of gaseous metabolism delimited by two points of in flection the first corresponding with values of pH grouped about the neutrality point and extending on the acid side to the value 6 6 As lower values of pH are reached the metabolism exhibits considerable diminution the zone between 6 6 and 6 0 being one of medium metabolism which ends in conditions approxi mating to physiological conditions For values below 6 0 metabolism rapidly falls and becomes zero at 5 3 muscular proteins ceasing to absorb oxygen in the neighbourhood of their isoelectric point —**L De Caro** Energy of growth of *Sterigmatocystis Nigra* The

'energy of preservation' of this organism is measured directly by determining the carbon dioxide developed by the mycelium when it is transferred to a nutrient liquid devoid of phosphate The lack of phosphate inhibits further growth, so that the carbon dioxide liberated under these conditions expresses the consumption of energy inherent to the preservation of life in the cells formed. This energy from the commencement of its formation to the 72nd hour, amounts to 1 407 Calories Knowledge of this value allows of the calculation of the real energy of growth, which is somewhat greater than that calculated on different lines for *Aspergillus niger* by Terroine and Wurmser, and is of the same order of magnitude as the energy of growth in the development of the egg

VIENNA

Academy of Sciences, Nov 2—E A W Schmidt The half period of radium D About twenty-five years

Nov 8—L Moser and K Schutt Determination and separation of rare metals from other metals (12) Separation of lithium from potassium, sodium, and magnesium Better than the fluoride and phosphate methods are those which depend on the solubility of dry lithium chloride in water free organic solvents such as iso butyl alcohol Lithium is separated from magnesium by precipitating the magnesium by *o* oxy quinoline—E Heinricher Anomalous blossoms of the crown imperial (*Fritillaria imperialis*) One race is sexually sterile, another race is sexually fertile but self sterile

Diary of Societies

FRIDAY FEBRUARY 15

GEOLOGICAL SOCIETY OF LONDON at 3—Annual General Meeting

ROYAL ASTRONOMICAL SOCIETY (Geophysical Discussion) at 4 30—Geophysical Methods in Surveying. Chairman Sir Gerald Lenox Conyngham. Speakers Mr Broughton Hedge Dr W F P McClintock and others

BRITISH INSTITUTE OF RADIOLOGY (Medical Members), at 5—Informal Discussion on Chest

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5—Prof H A. Harris Bone Growth in Health and Disease

INSTITUTION OF MECHANICAL ENGINEERS (Annual General Meeting) at 6—H J Ward Refrigeration on Shipboard

INSTITUTE OF TRANSPORT (at Midland Hotel Manchester), at 6 30—C D Campbell Inland Water Transport

SOCIETY OF DYERS AND COLOURISTS (Manchester Section jointly with Manchester Section of Oil and Colour Chemists Association) (at Literary and Philosophical Society Manchester) at 7—F Scholefield The Ostwald Colour System

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group—Informal Meeting) at 7—Discussion on the Stephan H Tyng Foundation Prints

SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) (jointly with all Glasgow Chemical Societies) (at 207 Bath Street Glasgow) at 7 30—Prof G T Morgan Chemical Studies of Coal Tar Products

JUNIOR INSTITUTION OF ENGINEERS, at 7 30.—E G Ritchie Steam Storage.

ROYAL SOCIETY OF MEDICINE (Obstetrics Section), at 8—Prof J Heyman The Uses of Radium in the Treatment of Malignant Disease of the Uterus and Ovaries

ROYAL SOCIETY OF MEDICINE (Electro Therapeutics Section), at 8 30—Discussion on Chronic Rheumatism of Joints and Muscles Diagnosis and Treatment.—Opening Papers—Dr D D Maplas Radiological Diagnosis Dr C W Buckley Spa Electro-therapy Dr F D Howitt Electro-therapy

ROYAL INSTITUTION OF GREAT BRITAIN at 9—Dr E K Rideal Chemiluminescence.

ROYAL AERONAUTICAL SOCIETY (Yeovil Branch)—Dr E G Richardson Modern Aerofoil Experiments (Lecture)

SATURDAY FEBRUARY 16

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (Yorkshire District) (at Beverley) at 11 15

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Associates and Students Section) (at Newcastle upon Tyne), at 2 30 J H Forster The Lubrication of Colliery Coal Tubs

PHYSIOLOGICAL SOCIETY (in Physiological Laboratory, University Birmingham), at 3—J C Bramwell and R. Ellis The Crescendo Murmur in Mitral Stenosis—Lilian M Pickford and Dr E. B Verney Renal Adaptation—Prof J Barcroft and H Florey Comparison of Vascular Changes in Spleen and in Small Intestine—W V Thorpe A Vasodilator Substance in Heart Muscle—I de Burgh Daly An Attempt to Measure the Blood Capacity of the Pulmonary Capillaries—Demonstrations—W V Thorpe (*a*) Small Hot-Funnels (*b*) Small Tissue Press—J C Brash Specimens from Madder Fed Animals Illustrating Bone Growth—H M Fox Constant Pressure Apparatus for Recording the O_2 Intake of Small Animals Adapted for Class Purposes.—D L. Gunn Apparatus for Studying the Reactions of Insects to Temperature and Humidity Changes—I de Burgh Daly (*a*) A Simple Arrangement for Making the Closed Circuit Heart Lung Preparation under Negative Pressure Ventilation (*b*) A Model Illustrating some of the Effects of Respiration upon the Pulmonary Blood Vessels—W R McRobert Siderosis of the Spleen in the Resting and Exhausted Rat.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr E Bullock Music in Cathedral and Collegiate Churches (II)

BRITISH PSYCHOLOGICAL SOCIETY (at Royal Anthropological Institute), at 3—J C Flugel and Miss Eve Macaulay The Psychology of Clothes in Adults and Children Some Results by the Questionnaire Method

EUGENICS SOCIETY (at Rembrandt Hotel Brompton Road) at 7 15.—Major L. Darwin The Coming of Age of the Eugenics Society (Galton Lecture)

MONDAY, FEBRUARY 18

VICTORIA INSTITUTE (at Central Buildings Westminster), at 4 30.—Lieut Col T C Skinner The Ice Age its Astronomical Cause and the Bearing of Drayson's Discovery on the Biblical Account of the Deluge

INSTITUTION OF MECHANICAL ENGINEERS (Graduates Section), at 6 30—G Bird Railway Brakes

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting) at 7—R. J Morrison and others Discussion on Modern High Power Rectifiers their Development and Use

INSTITUTE OF CHEMISTRY (Leeds Area Section) (jointly with Society of Public Analysts—North of England Section) (at Great Northern Hotel Leeds) at 7 15 C H Manley and others Discussion on The Preservatives Regulations 1925 1927

BRADFORD TEXTILE SOCIETY (at Midland Hotel Bradford) at 7 30—P E King Artificial Silk Its Expansion in the Textile Industries (Lecture).

HUDDERSFIELD TEXTILE SOCIETY (jointly with Huddersfield Engineering Society) (at Huddersfield Technical College) at 7 30 Dr W Hatfield The Application of the Special Acid Resisting Steels in the Textile Industry

INSTITUTION OF AUTOMOBILE ENGINEERS (Glasgow Centre) (at Royal Technical College Glasgow) at 7 30—H K Thomas Some Investigations into the Performance of Tubular Radiators for Motor Vehicles

ROYAL INSTITUTE OF BRITISH ARCHITECTS at 8 J A. Gotch Modern Banks with Special Reference to the New Midland Bank Head Office

ROYAL SOCIETY OF ARTS, at 8—Sir Thomas M Legge Thirty Years Experience of Industrial Maladies (Shaw Lectures) (I)

INSTITUTE OF CHEMISTRY (Edinburgh and East of Scotland Section) (and Society of Chemical Industry—Edinburgh and East of Scotland Section) (at North British Station Hotel Edinburgh) at 8 S D Forrester Potentiometric Bromination of Naphthol Sulphonic Acids J G Mackay The Estimation of Sulphur in Rubber

ROYAL GEOGRAPHICAL SOCIETY (at Aeolian Hall) at 8 30—G Binney Hudson Bay in 1928

TUESDAY FEBRUARY 19

ELECTRICAL ASSOCIATION FOR WOMEN (at 179 Great Portland Street) at 3—The Construction Use and Maintenance of Electric Sewing Machines

ROYAL DUBLIN SOCIETY (in Science Room Ball's Bridge Dublin), at 4 15—Prof F E Hackett and others Discussion on The Changing Outlook on Physical Science

ROYAL INSTITUTION OF GREAT BRITAIN at 5 15—Prof J S Huxley Evolution and the Problem of Species (IV)

ROYAL STATISTICAL SOCIETY (at Royal Society of Arts) at 5 15—Dr A B Hill The Investigation of Sickness in Various Industrial Occupations

ROYAL SOCIETY OF MEDICINE at 5 30—General Meeting

ZOOLOGICAL SOCIETY OF LONDON at 5 30—Secretary Report on the Additions to the Society's Menagerie during the Month of January 1929—Lieut Col A E Hamerton Report on the Deaths occurring in the Society's Gardens during 1928 Lilian Russell The Comparative Morphology of the Elysioid and Aeolidioid Types of the Molluscan Nervous System and its Bearing on the Relationships of the Ascoglossan Nudibranchs—Dr M Evans Some Notes on the Anatomy of the Electric Eel *Gymnotus electrophorus* with Special Reference to a Mouth breathing Organ and the Swim bladder—C B Kloss Some Remarks on the Gibbons with the Description of a New Subspecies.—B N Schwanwitsch Studies on the Wing pattern of *Catagramma* and Related Genera of South American Nymphalid Butterflies—Jnanendra Lal Bhaduri The Persistence of a Left Posterior Cardinal Vein and the Presence of an Abnormal Vein opening into the Isthmus of the Liver in an Indian Toad—Dr G D Hale Carpenter Further Notes on the Fauna of Nkosi Island Lake Victoria

INSTITUTION OF CIVIL ENGINEERS at 6 A H Barker The Electrical Heating and Ventilation of Bourne and Hollingsworth's Premises Oxford Street

LONDON NATURAL HISTORY SOCIETY (at Winchester House E C) at 6.30—J G Payne E B Bishop and others Debate Are the Artificial Introduction of New Species and the Formation of New Localities for Existing Species of the British Flora Justifiable?

ILLUMINATING ENGINEERING SOCIETY (in Lecture Theatre Home Office Industrial Museum Horseferry Road) at 6.45—Discussion on Various Problems in Illuminating Engineering—S G Elliott The Lighting of the New Piccadilly Underground Station—E Stroud The Lighting of the Royal Horticultural Hall—G Herbert The Lighting of a New Factory in London with over 1000 Units—R. A Ives The Lighting of the Wembley Kinema Theatre—J E Buckell An Example of Daylight Effects obtained with Artificial Light

INSTITUTION OF ELECTRICAL ENGINEERS (North Western Centre) (at Engineers Club Manchester) at 7—W Cruickshank Voice Frequency Telegraphs.

INSTITUTE OF METALS (Birmingham Local Section) (jointly with Birmingham Metallurgical Society and Staffordshire Iron and Steel Institute) (at Engineers Club, Birmingham) at 7—E C Evans Fuel

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (at Liverpool University) at 7 30—H B Atkinson How Electricity does Things (Faraday Lecture).

Institution of Automobile Engineers (Wolverhampton Centre) (at Engineering and Scientific Club Wolverhampton), at 7 30 —H K. Thomas Some Investigations into the Performance of Tubular Radiators for Motor Vehicles

Manchester Athenæum Textile Society (at Manchester College of Technology) —Dyeing (Lecture).

WEDNESDAY February 20

Royal Meteorological Society at 5 L H G Dines The Baker Automatic Release for Dropping the Meteorograph from a Registering Balloon at a Predetermined Height —C K M Douglas Some Aspects of Surfaces of Discontinuity —Dr E Kidson and H M Treloar The Rate of Ascent of Pilot Balloons at Melbourne

Geological Society of London at 5 30 —Dr C A. Matley The Basal Complex of Jamaica with Special Reference to the Kingston District with Petrological Notes by F Higham

Royal Photographic Society of Great Britain at 6 —G E W Herbert In and Out of Bruges

Institution of Electrical Engineers (Tees Side Sub Centre) (at Cleveland Technical Institute Middlesbrough), at 7

North East Coast Institution of Engineers and Shipbuilders (Graduate Section) (at Newcastle upon Tyne) at 7 15 —W G Thompson Some Unusual Aspects of Combustion in Engines and Boilers.

Institution of Automobile Engineers (Birmingham Graduates) (at Queen s Hotel Birmingham), at 7 30.—E M Frank Valve Gear for High speed Singles

Society of Chemical Industry (Nottingham Section) (jointly with Society of Dyers and Colourists) (at University College Nottingham) at 7 30 —A Stowers Steam Storage as an Aid to Economy in the Dye House

Institution of Electrical Engineers (Sheffield Sub Centre) (at Royal Victoria Hotel Sheffield) at 7 30 —Lt Col K. Edgcumbe Address

Glasgow University Alchemists Club (at Glasgow University) at 7 30 —Prof Kendall The Abuse of Water

Royal Society of Arts at 8 —J Morton History of the Development of Fast Dyeing and Dyes

Folk Lore Society (Annual Meeting) (at University College), at 8 —Prof R M Dawkins Folk Lore and Literature (Presidential Address)

Royal Microscopical Society, at 8.—Dr R G Canti and F G Spear Some Effects of Radium on Cell Division *in vitro* —S F Fox Some Effects of X Rays on Cell Division *in vitro* —F G Spear An Effect of Low Temperature on Cell Division *in vitro* —Demonstrations —S F Cox The Effect of a Heavy Dose of X Rays on Living Cells as shown by the Dark Ground Method —Dr R. G Canti Demonstration of Cell Division in the Living Tissues cultivated *in vitro*

Haslingden Textile Society —J W Pennington The Position of Artificial Silk in Relation to the Cotton Industry

THURSDAY February 21

Royal Society at 4.30 —P Kapitza The Change in Electrical Conductivity in Strong Electric Fields Parts I and II —R R. Nimmo and N Feather An Investigation of the Ranges of the Long Range a Particles from Thorium C and Radium C using an Expansion Chamber —C R. Burch Some Experiments on Vacuum Distillation —*To be read in title only* —Prof E C C Baly and N R Hood The Photosynthesis of Naturally Occurring Compounds (IV).—R Alty and B W Currie Adsorption at a Water Surface (I).—W G Palmer Some Adsorption Isothermals for a Plane Platinum Surface —B Lambert and A M Clark Studies in Gas Solid Equilibria —G C Laurence Relative Velocities of the Alpha Particles emitted by certain Radioactive Elements —H W Thomson and C N Hinshelwood The Mechanism of the Homogeneous Combination of Hydrogen and Oxygen —E G Dymond and E E Watson Electron Scattering in Helium —E T Hanson Diffraction and Resonance —S Goldstein (*a*) The Forces on a Solid Body Moving through Viscous Fluid (*b*) The Steady Flow of Viscous Fluid past a Fixed Spherical Obstacle at Small Reynolds Numbers —J Taylor On the Chemical Interaction of Ions and the Clean up of Gases at Glass Surfaces under the Influence of the Electrical Discharge —L. Hartshorn and D A Oliver On the Measurements of the Dielectric Constants of Liquids with a Determination of the Dielectric Constant of Benzene —J W Fisher The Wave Equation in Five Dimensions.—Prof H M Macdonald The Total Reflexion of Electric Waves at the Interface between two Media —K Lonsdale The Structure of the Benzene Ring in $C_6(CH_3)_6$.—Dr E Griffiths and J H Awbery Measurements of Flame Temperatures

Royal Institution of Great Britain at 5 15 —Prof A O Rankine Physics in Relation to Oil Finding (I)

Institution of Mining and Metallurgy (at Geological Society) at 30

Society of Chemical Industry (Birmingham and Midland Section) (at Birmingham University) at 7 —Prof W N Haworth Recent Views on the Structure of Cellulose and Starch

Institution of Automobile Engineers (London Graduates) (at Watergate House, Adelphi), at 7 25 —C Russell Some Notes on Gear Production

Institution of Electrical Engineers (Irish Centre—Dublin) (at Trinity College Dublin) at 7 45 —Dr K Ott The Erection of the Mechanical and Electrical Part of the Shannon Scheme.

Chemical Society at 8 —Dr R G W Norrish (*a*) Photochemical Equilibrium in Nitrogen Peroxide Part II The Dependence of Quantum Efficiency on Wave Length (*b*) Part III A Comparison of the Thermal Photochemical and Electrical Decompositions, and a General Theory of the Change (*c*) Part IV Fluorescence and Photochemical Activity —A. T Dann and W Davies The Reactions of Nitrosulphonylchlorides Part I The Reaction of Hydrazine Hydrate with *o*-nitrosulphonyl Chlorides

Royal Society of Tropical Medicine and Hygiene (at 11 Chandos Street W), at 8 15 —Dr L. W Hackett Malaria-Control through Anti Mosquito Measures in Italy

Institution of Mechanical Engineers (Midland Branch) (at Birmingham).—Chairman s Address

FRIDAY February 22

Imperial College Chemical Society (in Main Chemistry Lecture Theatre Royal College of Science), at 5 —Dr F A. Freeth The Qualifications of an Industrial Chemist.

Physical Society (at Imperial College of Science), at 5 —L. F Stanley The Construction and Calibration of a Sensitive Form of Pirani Gauge for the Measurement of High Vacua.—Prof C. H Lees The Free Periods of a Composite Elastic Column or Composite Stretched Wire.—Dr A. Ferguson and J A Hakes A Capillary Tube Method for the Simultaneous Determination of Surface Tension and of Density —Demonstration of a Standard Electrostatic Voltmeter and Wattmeter used for Measurements of Alternating Currents at Power Frequencies at the National Physical Laboratory, by Dr E. H Rayner

North East Coast Institution of Engineers and Shipbuilders (in Mining Institute Newcastle upon Tyne), at 6 —Dr G W Todd The Relation between the Properties of Engineering Materials and their Ultimate Structures

Institution of Electrical Engineers (London Students Section) (jointly with Institutions of Civil and Mechanical Engineers) at 6 15 —W Ford Standardisation

Royal Aeronautical Society (Students Section), at 6 30 —L. T Brown The Napier Lion Engine

Manchester Literary and Philosophical Society (Chemical Section) at 7

Institution of Mechanical Engineers (Informal Meeting) at 7 —G Baker Electrical Precipitation

Royal Photographic Society of Great Britain at 7 —G C Weston Enlarging

West of Scotland Iron and Steel Institute (at Royal Technical College Glasgow), at 7 —Dr W H Hatfield The Response of Steels at Elevated Temperatures

Blackburn Textile Society (at Blackburn Technical College), at 7 30 —W A. Walsh Some Recent Improvements in Textile Machinery (Lecture)

Junior Institution of Engineers at 7 30 —J Calderwood The Application of the Heavy Oil Engine to Yachts and Small Craft

Royal Society of Medicine (Epidemiology Section) at 8 —Surg -Comdr S F Dudley Human Adaptation to the Parasitic Environment.

Royal Institution of Great Britain at 9 —Dr F A Bather Lily Stars of the Sea How they fit their Surroundings

Institution of Mechanical Engineers (Manchester Branch).

Todmorden Textile Society —S. Taylor Winding and Warping (Lecture).

SATURDAY February 23.

Royal Institution of Great Britain at 3 —Dr E Bullock Music in Cathedral and Collegiate Churches (III)

PUBLIC LECTURES

FRIDAY, February 15

London School of Economics, at —C E R Sherrington Motor Transport and Urbanisation of the Countryside

Surveyors Institution at 5 30 —G Atkinson Salvaging the Fleet at Scapa Flow (Lecture in connexion with the Institution of Professional Civil Servants)

SATURDAY February 16.

Horniman Museum (Forest Hill), at 3 30 —Miss I D Thornley Travel and Travellers in the Middle Ages

MONDAY February 18

King s College of Household and Social Science at 5 15 —J A Spender America and British American Relations

King s College, at 5 30 —Prof R. R Gates Botanical and Anthropological Explorations in the Canadian Arctic

East Anglian Institute of Agriculture (Chelmsford), at 7 —Prof N M Comber Soil Problems

TUESDAY February 19

Birkbeck College at 5 30 —Sir Charles Oman The History of the Coinage of England (Succeeding Lectures on Feb 26 and Mar 5)

University College at 5 30 —Prof Ethel M Elderton Growth Curves in Women from Childhood to Old Age

University of Leeds, at 8 —Prof W E Soothill China s Contribution to Western Civilisation

WEDNESDAY February 20

Institution of Electrical Engineers at 5 30 —L Emanueli High Voltage Cables (Succeeding Lectures on Feb 22 26 Mar 1 and 5)

THURSDAY February 21

East London College at 5 30 —Dr C H Lander The Burning of Fuel Solid Liquid and Gaseous

University College, at 6 —Col G S C Cooke The Ordnance Survey—its Work and Maps.

FRIDAY, February 22

London School of Economics at 5 —C E R Sherrington Air Transport and the Disintegration of Economic Barriers

University College at 5 30 —Dr J H Jones Hygiene of the Mercantile Marine (Succeeding Lectures on Mar 1 and 8.)

SATURDAY February 23

Horniman Museum (Forest Hill) at 3 30 —Dr Barnard Smith Zermatt and its Glaciers

EXHIBITION

February 19 to March 16

University College.—Exhibition of Recent Work in British Archæology Public Lectures in connexion with the Exhibition —

Tuesday Feb 19 at 5 30
C R. Peers Archæology and the State.

Wednesday, Feb 27, at 5 30
Prof R. A S. Macalister Recent Archæological Work in Ireland

Wednesday Mar 6 at 5 30.
Dr C Fox Recent Archæology in Wales and its Borders.

SATURDAY, FEBRUARY 23, 1929

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The Position of British Veterinary Education and Service

THERE has just been issued the Report of a Committee appointed by the Secretary of State for the Colonies to inquire into the conditions of the Colonial Veterinary Service (H M S O Cmd 3261 Price 9*d* net) The Committee which was presided over by Lord Lovat was asked to frame proposals for obtaining the highest degree of efficiency in regard to veterinary research and administration in the non self governing dependencies that financial considerations permit The questions considered and reported upon include the recruitment and training of veterinary officers their conditions of service the organisation of research and intelligence and the setting up and support of any institutions required The entire field has apparently been very thoroughly explored and the report makes illuminating and very disquieting disclosures of the great difficulties under which veterinary education and training are carried out in Great Britain Referring to the dilapidated condition of the Royal Veterinary College at Camden Town the Committee says

It is nothing short of a national disgrace that such a condition of affairs should be allowed to continue The blame does not lie with the teaching staff labouring as they do under the great disadvantage of inadequate salaries in a school which is both inadequately staffed and equipped On the contrary they have made great personal sacrifices and have themselves provided much of the existing equipment

Indeed it is within our knowledge that on more than one occasion in years of financial strain the teaching staff of the College have submitted to a considerable reduction of their already inadequate salaries and that at times when most salaried officials such as those of the Civil Service were in receipt of a yearly bonus on account of the increased cost of living

Veterinary schools in this country receive but little help from the State and have to rely mainly on students fees When we compare the large veterinary institutions in other countries supported principally by State funds with those that exist in Great Britain the contrast is somewhat depressing

The Veterinary College of Berlin receives an annual grant from the State of £28 000 while since the War a new veterinary college has been built at Leipzig at a cost of more than £1 000 000 It is not to be wondered at therefore, that the Committee is convinced that existing conditions

in Great Britain and overseas "should no longer be tolerated" A new policy, on comprehensive lines and with adequate financial support, is needed and should be carried out boldly

Veterinary activities can no longer be limited to the mere treatment of specific diseases or even the prevention of epizoötic and enzoötic diseases The advance of agriculture—the staple industry of almost all the dependencies of the British Empire—is closely associated with animal husbandry in its widest sense, and animal nutrition and animal genetics are of the highest economic importance, while the successful development of public health involves problems of improved milk and meat supply Moreover, the advance of modern medical science—so largely the result of observations on animals—requires the continuous collaboration of veterinarians in the solution of such problems as insect borne diseases like the trypanosomiases or the virus diseases

The economic aspect of stock rearing alone would justify the provision of adequate measures for combating animal diseases and improving the health and nutrition of the flocks and herds Between 1914 and 1925 the cattle population of Nigeria was reduced by as much as 25 per cent, almost entirely through rinderpest This same disease in two outbreaks destroyed 5,000,000 head of cattle in South Africa south of the Zambezi, representing a loss of £20,000,000

The Lovat Committee is of opinion that the veterinary departments of the colonies are generally understaffed and that the conditions of service do not attract enough recruits of the type required, such as those combining technical proficiency with the personal qualities which are essential if the veterinary officer is to enforce his often disturbing regulations without undue friction The colonies must make their veterinary services more attractive The status and prestige and conditions of service of veterinary departments must be improved, and it will be necessary to offer higher salaries, particularly in the senior grades

The present veterinary course of training in Great Britain, with the standard of preliminary general education identical with that demanded by the General Medical Council, consists of a four years' (membership diploma) or a five years' (university degree) course, with post graduate courses for additional diplomas There is no special training, however, in tropical veterinary science comparable with that provided for candidates for the colonial medical services at the schools of tropical medicine, and the Committee recommends that all newly appointed officers should undergo in Great Britain a course of instruction in tropical veterinary science before proceeding overseas

If the recommendations of the Lovat Committee are adopted, the veterinary services will no longer be regarded as the Cinderella of the services, and opportunities will be afforded for utilisation of the best types of recruits for veterinary research As Sir Arnold Theiler recently stated in referring to such matters, British veterinarians have brain and ability second to none in the whole world if they are only afforded the opportunity of applying them

To remedy this condition of affairs, it is recommended that fundamental veterinary education in Great Britain must be supported in such a way that the stigma of a "national disgrace" shall be removed, and that a system of scholarships be instituted to attract more men with a scientific training and with an aptitude for research There should also be a special post graduate training, for which purpose there should be established a school of tropical veterinary science modelled on the lines of the London School of Tropical Medicine, and it should be closely linked with a veterinary college and affiliated to a university so as to be eligible for a grant from the University Grants Committee

To complete its work, the Committee has made striking recommendations for the provision of headquarters organisations, the organisation of research with the establishment of a central research station adequately equipped and staffed, and the provision of a Colonial Veterinary Service available for service in any part of the Colonial Empire and not limited to any particular colony In regard to this service the Committee says "The veterinarian of the highest ability will enter the Colonial Services only if he is offered a career sufficiently attractive in pay and prospects to satisfy his ambitions as a scientific worker"

Much of this report cannot but be of considerable assistance to the departmental committee appointed by the Minister for Agriculture, sitting, at present, to inquire into the requirements for veterinary education in Great Britain, with particular reference to the Royal Veterinary College, Camden Town, and we earnestly hope that, as the result of recommendations of two such strong committees, the "national disgrace" at Camden Town will be reconstituted and endowed in such a manner as to become a credit as the senior and most important veterinary college of the British Empire

Invertebrate Fauna of Rapid Waters

Contribution à l'étude des invertébrés torrenticoles Par Dr Étienne Hubault (Suppléments au *Bulletin biologique de France et de Belgique*, Supplément 9) Pp 388 + 10 planches (Paris Les Presses universitaires de France , London Dulau and Co , 1927) 85 francs

FRESH-WATER biology, much neglected in the past, is rapidly becoming the subject of intensive and valuable study Until recently the majority of investigators into such problems as adaptation, evolution, migration, and geographical distribution have turned largely to the sea for material But these phenomena are exemplified in almost, if not quite as marked a degree, by the more accessible inhabitants of fresh waters as by the denizens of the deep Vast lake and tiny pool, clear spring and stagnant pond, rushing stream and trickling rivulet—each has its own characteristic inhabitants specially adapted for life under the particular set of environmental conditions found therein Moreover, as in the sea, each of these principal types of habitat, such as hill streams, contains within itself numerous subsidiary types of habitat differing fundamentally one from another, and each harbouring its own particular group of organisms

Specially welcome, therefore, is Dr Hubault's contribution to the study of the invertebrate fauna of rapid waters This most exhaustive work of superlative value is at once systematic, physiological, and biological The systematic portion of the work consists of an enumeration of the organisms actually studied and collected by the author in the course of his researches, with a table showing the general distributions of all the species determined with certainty The physiological portion includes in its scope detailed observations on the temperature, salinity, and oxygen content of the waters of hill streams, and the parts played by these factors in determining the distribution of a hill stream fauna

The last named factor Dr Hubault has made the subject of detailed investigation, especially with regard to the distribution of oxygen in the different parts of hill streams and the annual rhythm of this distribution He finds that, near the source, the water is always rich in dissolved oxygen—slightly less so in summer than in winter, but the difference is negligible In the lower reaches, on the contrary, there is a marked seasonal variation, the water being poor in dissolved oxygen during the warmer months and relatively rich during the colder months of the year Thus, in summer there is a considerable difference between the oxygen content of the upper and lower reaches of rivers and streams, while in winter the uniformly cold waters are throughout rich in oxygen Nevertheless, although there is little or no seasonal variation near the source, there is a noticeable 'diurnal oscillation' of oxygen concentration, the volume of water here being small, and considerable diurnal change of temperature taking place The concentration reaches a maximum about sunrise, and falls to a minimum shortly after mid day Change of temperature alone is held to be responsible for this daily rhythm, phytoplankton being non existent, and other aquatic vegetation scanty Farther down where the volume of water is greater, the temperature remains practically uniform throughout the twenty four hours, and there is no 'diurnal oscillation' of oxygen concentration

A striking example is given of the effect of the action of aerobic bacteria in reducing the oxygen content of water, and thus constituting a very real menace to the life of higher organisms On the banks of the small stream Saint Benoît there are, at one place about the middle of its course, four potato starch factories situated a short distance apart In November 1924 the difference in oxygen concentration immediately above and below these factories was 1 55 c c per litre, in spite of the fact that the stream was then in flood In October 1925 the stream was normal and, although only three factories were working, the difference above and below them was 1 73 c c per litre

Correlated with these investigations on oxygen concentration and distribution, the author has determined the oxygen consumption of various organisms from different fresh water habitats He finds that forms found in rapidly running or other waters more or less uniformly cold throughout the year have, in general, a higher oxygen consumption than those found in waters such as slowly moving streams, where the temperature rises considerably in summer The amount of dissolved oxygen present in the water is therefore an exceedingly important factor in determining the distribution of the inhabitants of fresh waters

In this connexion Dr Hubault lays great emphasis on the fact that, in the life of the inhabitants of rapid waters, the actual current plays only a secondary rôle, the primary conditions governing their existence being such factors as temperature, salinity, and, more particularly, oxygen concentration Only in running waters do these organisms find those physico-chemical conditions which are essential to them Of necessity,

therefore, they must 'put up with' the current—an inconvenient mechanical force which they have overcome with varying degrees of success by means of a remarkable series of tropisms and morphological adaptations, ranging from those exhibited by the most highly specialised forms adapted for life in cascades and waterfalls, down to the very slight modification of such as although living in streams, ensconce themselves amongst moss or under stones where the current is little felt Chapter v is devoted to the study of tropisms, especially the three principal tropisms exhibited by these hill stream organisms—rheotropism, stereotropism, and phototropism with its corollary nycthemeral rhythm—upon which the author has made extensive observations

Chapter vi deals mainly with the biology of the Trichoptera and Blepharoceridæ The former group is considered only in outline the latter more fully, the author having focused his attention particularly upon *Liponeura vogesiaca* nov sp the biology of which he has followed out in detail in the upper courses of the river Meurthe in the High Vosges

Finally, Dr Hubault passes in review the evidence bearing upon the origin of a rapid water fauna An extensive bibliography of more than three hundred references completes the work

G A S

Progress of Research in Tropical Medicine

(1) *An Introduction to Medical Protozoology with Chapters on the Spirochætes and on Laboratory Methods* By Lieut Col Robert Knowles Pp xii + 887 + 15 plates (Calcutta Thacker, Spink and Co, London W Thacker and Co, 1928) Rs 25

(2) *Recent Advances in Tropical Medicine* By Sir Leonard Rogers Pp viii + 398 (London J and A Churchill, 1928) 12*s* 6*d* net

IN a little more than a quarter of a century the patient and often brilliant researches of numerous scientific workers have elucidated many difficult problems regarding the causes and dissemination of diseases so prevalent in the tropics The parasites of malaria, sleeping sickness, relapsing fever, amœbic and bacillary dysentery, cholera, plague, and leprosy are now readily detected It is perhaps of even greater importance that in many instances the life histories and transmission of these organisms to man have been clearly demonstrated

Such discoveries have placed in the hands of the hygienist methods of control against the spread of disease, which in time will convert huge tracts of valuable territory previously known by such names as 'the white man's grave' into veritable health resorts

Our present knowledge regarding some of these diseases might seem to be ample and complete, but there is no finality, as is exemplified by the continued careful investigations which are being carried on all over the world New facts regarding the parasites and the bionomics of their vectors are being slowly accumulated, and many unknown factors await elucidation in order to place the control of such diseases as malaria or sleeping sickness over large areas of the tropics on an economic basis

(1) A striking example of the growth of knowledge regarding diseases of man and other animals is afforded by the publication of the substantial volume before us entitled An Introduction to Medical Protozoology Here Lieut Col Knowles, in an interesting manner and in a style peculiarly his own describes those unicellular animals which parasitise man The most interesting chapters are those on leishmaniasis (kala azar and Oriental sore) for the author was one of those concerned with the initiation of a new line of research The causal organism of this disease was discovered independently by Leishman and Donovan in 1903 Rogers, the following year, succeeded in cultivating the parasite, so demonstrating that during a part of its life history it became a motile flagellate known as a leptomonad or herpetomonad

The problems concerned with the transmission of leishmaniasis have for years baffled all workers Bed bugs, fleas, lice, mosquitoes, and other blood sucking arthropoda have been studied, but no proof was forthcoming to show that any of these was responsible A new line of investigation was opened up by Sinton in 1922, who noted that the distribution of a certain species of sand fly (*Phlebotomus argentipes*) corresponded geographically with kala azar Knowles, Napier, and Smith (1924) quickly demonstrated that laboratory-bred specimens of this fly could be readily infected with leptomonad flagellates when fed on cases of kala-azar Christophers, Shortt, and Barraud confirmed this, and the Indian commission composed of Shortt, Barraud, and Craighead has definitely shown that the flagellates make their way forwards in *Phlebotomus argentipes* to the buccal cavity, pharynx, and biting parts All attempts to infect man or a susceptible animal (the Chinese hamster) by the bites of experimentally infected sand flies have failed Workers in China have confirmed the observations of those in India

In Palestine, Adler and Theodor have infected *Phlebotomus papatasii* by feeding it on 'Oriental sore,' and here again the flagellates make their way forward to the proboscis of the fly Experimental production of cutaneous leishmaniasis, however, has not been accomplished through the bite of infected flies, although the crushed-up contents of the gut inoculated into the skin of man produces a typical sore

These researches indicate that certain species of sand flies act as the vectors of visceral and cutaneous leishmaniasis, but that some unknown factors involved in the transmission of both diseases to man require further investigation

(2) *Pari passu* with observations on the pathogenic parasites and the biology of their vectors, great progress has been accomplished in chemo therapy Sir Leonard Rogers has compiled a most valuable short book on "Recent Advances in Tropical Medicine" Here he gives a lucid account of the remarkable advances in the treatment of diseases by drugs The use of sodium or potassium antimony tartrate, for example, in the treatment of kala-azar, Oriental sore, and schistosomiasis is a triumph of modern therapy The introduction of 'Bayer 205' and tryparsamide for the cure of African sleeping sickness, and emetine in the treatment of amœbic dysentery and liver abscess, has added potent preparations to the pharmacopœia

Rogers has demonstrated the value of hypertonic alkaline injections in the treatment of cholera, and also has reported most interesting results in cases of leprosy which have been treated with injections of chaulmoogra oil and its derivatives His results far surpass those given by any other treatment of this most dreaded of diseases

In conclusion, attention must be directed to some very important researches recently made on yellow fever In 1901, Reed, Carrol, and Agramonte proved that the vector was *Aëdes argenteus* (*Stegomya fasciata*) The organism remained unknown, but interest was revived in it in 1919 by Noguchi, who announced that the causal organism was a spirochæte (*Leptospira icteroides*) Other workers failed to confirm Noguchi, and a commission of the Rockefeller foundation continued researches in West Africa Stokes, Noguchi, and Young lost their lives during these investigations, and recently the whole evidence points to the fact that the causal organism is a filterable virus Great credit is due to Dr Sellards, of Harvard University, who brought to England in 1928 the frozen virus from Dakar which enabled researches to be continued in this country Hindle, by applying the technique successfully used by Laidlaw and Dunkin in the protection of dogs against dog distemper, has prepared vaccines from the liver of yellow fever monkeys which absolutely protect monkeys against large doses of the virus Aragão (1928) has proved the viruses of America and the west coast of Africa to be identical, and, further, has used the protective vaccine with apparently good results in a small epidemic in Brazil About three or four hundred people were vaccinated, and none of those so treated caught yellow fever Evidence points to the important fact that by the use of vaccine the population can be protected absolutely from the ravages of an epidemic of yellow fever

J G THOMSON

Historical Aspects of Science

The Bases of Modern Science By J W N Sullivan Pp x+246 (London Ernest Benn, Ltd, 1928) 12*s* 6*d* net

IT is, perhaps, not unnatural at a time when science is developing at an unprecedented and somewhat embarrassing rate that the study of the history and philosophy of science should have fallen into neglect When the newspaper is so interesting, it is not surprising that the historical treatise meets with less than its due share of attention It is unfortunately true that very few of our physics students of to day have any clear conception of the way in which their subject has been developed, and this neglect of the historical or, as some prefer to term it, the humanistic aspect of science is a weakness in science teaching which is being more and more generally recognised One of the difficulties in introducing this desirable element into our studies has undoubtedly been the absence of suitable books It is true that a few men of science have achieved the distinction of a biography, but it is the history of science rather than the lives of men of science with which we wish to concern ourselves, it is the development of ideas, and not of men, which is our proper study, and of such histories there are very few in the English language

It is from this aspect that we welcome this very able and interesting volume from the pen of Mr J W N Sullivan The title, "The Bases of Modern Science," is perhaps a little misleading The book deals only with physical science, and there are others (a fact which physicists are perhaps a little prone to forget), and only about half of the book deals directly with what we call modern science What Mr Sullivan has done, and done

well, is to give us, without bewildering and unnecessary detail, and without the intrusion of ugly mathematical formulæ, a history of the growth and development of physical science from the time of Copernicus to the present day He has traced in a simple but adequate way the rise, decline, and fall of the different conceptions which have dominated physics in that interval, and has attempted to make clear the often unspoken ideas and aims in the minds of those who formulated them

Mr Sullivan has selected the material for his purpose well, and has marshalled it with skill Though the book is short in comparison with the vastness of its subject matter, the treatment is by no means superficial, and though it cannot be called light reading, it holds the attention and the imagination from beginning to end It is not likely that the more advanced physicist will find himself in agreement with all that the author puts forward There is apt to be more disagreement on the bases and aims of science than on its methods and results Some of the disagreement will be more verbal than real Mr Sullivan, for example, uses the term 'mathematical' in a much broader sense than that to which we are accustomed, so broad, indeed, that it allows him to describe Faraday as "a mathematical genius" It is presumably in this wider sense that we must understand the word when he insists, as his main contention, that the aim of science is a mathematical description of the real world It is, however, immaterial whether we agree with the author or not He has written a book which will widen the outlook and deepen the interest of the new generation of science students, and one which they should certainly be advised to read.

It is only fair, in conclusion, to record that the author describes his book as "an attempt to expound the main ideas of physical science in non technical language," and that it is intended for "intelligent readers who have had no scientific training" It is difficult to judge how closely such a reader will be able to follow Mr Sullivan's argument The language does not appear to be particularly different from that which a physicist would use in addressing fellow physicists, if he were fortunate enough to command Mr Sullivan's mastery of style Explanations are, however, given of the more unusual terms, and the non-scientific reader who is interested in scientific thought might be very well advised to attempt this book. He may not find it easy, but it is unlikely that he will be able to acquire any real understanding of the matter on easier terms.

J A C

Our Bookshelf.

Organic Chemistry a Brief Introductory Course By Prof James Bryant Conant Pp x+291. (New York The Macmillan Co, 1928) 10*s* 6*d*

In his preface the author states that he wishes to find a stimulating approach to organic chemistry, and so has deliberately departed from the usual arrangement found in most organic text-books of dealing first with methods of purification and analysis, and then with the paraffins, etc, in fact, he has definitely omitted all practical details throughout the book, leaving these to be dealt with in a practical course The alcohols are chosen as a starting-point, in view of their relationship to water, and from these there is a natural development of derived compounds

The author has certainly succeeded in giving a really readable exposition of organic chemistry The book is not a mere collection of facts and formulæ, but follows in a natural sequence from one compound to another, and though, as would be expected, it is by no means complete, it gives the main facts about the simpler compounds of each series

Moreover, the author has brought his facts up-to-date Thus the preparation of methyl alcohol from water-gas is fairly fully described, as is the use of butyl alcohol and its derivatives in the new nitro cellulose lacquers, whilst the cracking of petroleums and the use of ethylene from natural gas for the preparation of ethylene glycol are mentioned The only points noted to be incorrect are the statements that "gun cotton is a completely nitrated cellulose" and that "smokeless powder is made by treating gun-cotton with alcohol and ether" Otherwise the author has been successful in the difficult task of writing an interesting and at the same time accurate introduction to organic chemistry

J R H W

Graphische Darstellung der Spektren von Atomen und Ionen mit ein, zwei und drei Valenzelektronen Von Prof Dr W Grotrian (Struktur der Materie in Einzeldarstellungen, herausgegeben von M Born und J Franck, Band 7) Teil 1 Pp xiii+245 Teil 2 Pp x+168 (Berlin Julius Springer, 1928) 34 gold marks

This is a really admirable companion volume to tables of the simpler spectra such as A Fowler's or Paschen and Gotze's It may be said to cover the same ground as Fowler's book, for it deals only with the simpler spectra which exhibit singlet, doublet, or triplet terms, and not spectra of higher multiplicities, but it deals of course with many more examples of such spectra taken from other atoms in higher stages of ionisation It deals with them, too, in the light of the general systematisation of spectra which we now possess, which allows of a confident handling of the material at every stage

The book deliberately sets out to exhibit graphically the structure of the spectra in all their details, so far as this is possible The resulting 163 figures are published in a volume separate from the text, and for many purposes they will be found quite

admirable It is obvious that a working spectroscopist will require tables of wave-lengths, wave numbers, and terms as well as the best diagrams, and it is much to be hoped that this book will stimulate new editions of the classical tables we have mentioned, extended to cover the same material as Prof Grotrian's diagrams The text gives an excellent description of the simpler atomic spectra, their nature, origin, and analysis, in complete detail There is an especially admirable account of the finer details of the spectra of hydrogen and helium

R H F

The American Annual of Photography, 1929 Vol 43 Edited by Frank R Fraprie and E J Wall Pp 240 + Adv 68 (Boston American Photographic Publishing Co , London Sands, Hunter and Co , Ltd , 1928) 7*s* 6*d*

This long established annual is no longer just another of the same sort, although it includes a hundred or more pictorial illustrations and about twenty articles on various subjects by about as many different authors The pictures include a great variety of types of subjects, some excellent portraits and views, and a few that we can only refer to as grotesque Similarly, the articles range from the severely technical to the highly popular One of the special features is "Who's Who in Pictorial Photography, 1927–8" This is a list of the contributors to fifty exhibitions practically all over the world, with the number of exhibitions that each has contributed to and his total number of prints hung It includes similar lists for the two preceding years As each person's address is given, this unique feature will doubtless be useful to many

Among the articles that call for special notice is Mr E J Wall's "Practical Digest of the Year's Work in Photography" His recent death reminds us that this is the last time that we shall have the advantage of Mr Wall's wide knowledge and his ability to set forth the essence of the facts in an interesting and readable form There is also from his pen an article on the very early history of the daguerreotype process, "prompted by the discovery of an early pamphlet while the library of American Photography was being catalogued" This appears to settle some matters as to priority, etc , that have been in dispute for many years

The British Journal Photographic Almanac and Photographer's Daily Companion, with which is incorporated The Year Book of Photography and Amateurs' Guide and The Photographic Annual, 1929 Edited by George E Brown Pp 800 + 63 plates (London Henry Greenwood and Co , Ltd , 1929) 2*s* net

The general appearance and arrangement of this annual are well known Though not equal in size to the pre-War volumes, it is getting on in that direction The pictorial section, introduced a year or two ago, is growing, and the photogravure reproductions are of the usual high quality In turning over the pages there are two matters that force themselves upon one's attention in connexion with the progress of photography First, the large number of firms that make apparatus for general kinematography, cameras, projectors, and supplementary items, and the large range of prices charged for them, from £5 up to £250 , secondly, that although plates and films are more sensitive than ever before, lenses are being made with larger and still larger apertures, even up to $f/1\ 5$ The trend, therefore, continues to be in the direction of shorter exposures, and the results that were surprising a few years ago have become commonplace

The contribution of the editor is on photography in connexion with crime and the criminal, and is illustrated with several interesting examples, many of which are of foreign origin The technical and historical details are arranged in the same way as heretofore, and include a list of tables in past "Almanacs" that are not included in the present volume, with the dates when they last appeared

Soviet Union Year Book, 1928 Compiled and edited by A A Santalov and Dr Louis Segal Pp xxxi + 587 (London George Allen and Unwin, Ltd , 1928) 7*s* 6*d* net

This year book, now in its fourth year of publication, is much enlarged, though planned on the same lines as previously It opens with the constitution and foreign relations, and gives in full various decrees of the Soviet government The greater part of the book is devoted to the agriculture, mineral resources, foreign trade, and finance of the Union The section on foreign trade has been much expanded and now gives full details of imports from and exports to various countries These figures should prove useful, since they are not easily obtainable elsewhere Under the heading of education it is noted that the Soviet Union claims to have 6122 technical schools, 124 universities, and 109 workers' faculties There is also a long list of scientific institutes, the function of which is to assist in the industrial development of the country Two maps show mineral resources, and two others show the political divisions of the Union The list of books is almost entirely confined to publications in Russian

Some Fundamental Problems of Cellular Physiology By W J V Osterhout (The Third William Thompson Sedgwick Memorial Lecture Published under the Auspices of the Yale School of Medicine on the Foundation established in Memory of Dr William Chauncey Williams, of the Class of 1822, Yale Medical School, and of Dr William Cook Williams, of the Class of 1850, Yale Medical School) Pp vi + 55 (New Haven, Conn Yale University Press , London Oxford University Press, 1927) 4*s* 6*d* net

In this Sedgwick memorial lecture the author deals with the mechanism of certain fundamental activities of the cell, especially those depending upon the existence of semi-permeable surfaces in the living state

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications*]

Knock Ratings of Pure Hydrocarbons

IT is well known that different hydrocarbons, when used as fuels for internal combustion engines, possess different tendencies to detonate or knock, and one of the factors which decides the amount of knocking occurring is the chemical composition of the hydrocarbon used In the course of a research on the chemical analyses of gasolines and hydrocarbon mixtures generally, we have prepared pure samples of various hydrocarbons in fairly large quantities, being of the opinion that trustworthy methods of analysis can only be evolved by this method These hydrocarbons have recently been examined, through the kindness of the Anglo-American Oil Company, in an internal combustion engine, with the view of determining their knock ratings, this being done in an attempt to correlate chemical properties with engine performances

At the present time it is the commonly accepted idea that, of the four typical hydrocarbon groups, the aromatics possess the best anti knock values and paraffins the worst, olefines and naphthenes possessing intermediate figures of merit Some time ago Egloff and Morrell (*J I E C*, **18**, 354, 1926), using data obtained by Ricardo (Empire Motor Fuels Committee Report, 1924), described a method for the chemical analysis of gasolines which they claim is capable of indicating comparative anti knock values In this they assume, so far as anti knock properties are concerned, that 5 per cent of unsaturateds or 4 per cent of naphthenes is equivalent to 1 per cent of toluene, the paraffins being considered as knock inducers

Egloff and Morrell have themselves pointed out the discrepancies of such a generalisation, and only advise this analytical method for the determination of knock ratings in the case of those fuels which have been shown by analysis and motor tests to give check results (*Oil and Gas Journal*, Jan 27, 1927) More recently, Edgar (*J I.E C*, **19**, 145, 1927) has demonstrated that all paraffins must not be classed as knock inducers, for 2 4 4 trimethyl pentane, first described by him, has anti-knock properties equivalent to benzol (see also Boyd, *Oil and Gas Journal*, Jan 27, 1927)

Egloff and Morrell perforce based their method upon the only data at that time available, and seeing that Ricardo found it impracticable to use chemically pure hydrocarbons, it is imperative that the factors chosen for converting the different series into aromatic equivalents should afterwards be criticised Stevens and Marley (*J I E C*, **19**, 228, 1927), working on the same subject, used pure samples of heptane, methyl cyclohexane, hexylene, and toluene as representatives of the four typical hydrocarbon groups, and showed that under their experimental conditions, 1 per cent of toluene was equivalent to 2 per cent of either hexylene or methyl cyclohexane in its ability to suppress detonation It will be seen that these figures are not in agreement with those of Egloff and Morrell and Ricardo

Apparently, the failure of chemical analyses to give correlation with engine performances is due to the fact that the various members of one certain general hydrocarbon class, for example, olefines or aromatics, do not possess the same knock ratings For example, toluene is slightly better than benzene, whereas pseudo cumene has pro-knock tendencies (*Aeronautical Res Comm. Rep*, No. 1013, 1925), normal heptane is a very bad detonator, while Edgar's octane is a valuable anti knock

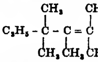
While studying the unsaturateds present in motor fuels, we have observed that the various members of this general class differ widely in their reactivities towards oxidising agents, and this gave us the idea that these hydrocarbons would possess widely different anti-knock values, this has been shown to be the case These unsaturated hydrocarbons were each separately dissolved in a highly paraffinoid spirit (sp g 0 7334 at 15° C, 72 7 per cent paraffins) which possessed exceptional tendency to knock The resulting blends were then matched with tetra ethyl lead dissolved in the same spirit The engine used was fitted with the Boyd and Midgley bouncing pin apparatus for the determination of knocking, and was run at a constant speed of 500 rev per minute throughout the tests A 20 per cent concentration of unsaturated hydrocarbon was maintained in each of the synthetic mixtures made

The following results were obtained

20	per cent	Cyclohexane	=1 0	c c	ethyl fluid per gallon
20	,,	Benzene	=2 1	c c	
20	,,	Cyclohexene	=2 4	c c	,, ,,
20	,,	Toluene	=2 75	c c	,, ,
20	,,	Pentene 2	=3 5	c c	,, ,
20	,,	Trimethyl ethylene	=4 5	c c	,,
20	,,	Diamylene	=6 0	c c	,, ,
20	,	Diisobutylene	=6 6	c c	,, ,

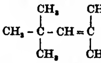
Owing to the difficulty of obtaining a sufficient amount of these hydrocarbons, it was not found possible to use synthetic mixtures containing a greater concentration than 20 per cent of the above substances

The diamylene was prepared by the polymerisation of trimethyl ethylene and has the probable structure



(Joubert and Norris, *J A C.S*, **49**, 873, 1927) As used, it had a boiling range of 150° 156° C

The diisobutylene has the structure



(Butleroff, *Chem Centralbl*, **2**, 1877, Kondakow, *J Prakt Chem*, **59**, 287, 1899), and is the olefine corresponding to Edgar's octane

The above results show that cyclohexene has anti-knock properties equivalent to benzene, while the others are far more effective than benzene, especially diamylene and diisobutylene, which at a concentration of 20 per cent are found to be equivalent to 37 5 per cent and 40 per cent benzol respectively Tested on the same scale, 20 per cent of toluene was found to be equivalent to 22 5 per cent of benzol Thus it will be seen that aromatic hydrocarbons have lower knock ratings than the above unsaturateds

Diisobutylene and diamylene offer certain advantages as anti knock dopes over benzol. Benzol has a freezing point too high (- 14° C) for aviation purposes when used in an undiluted state, and a 50/50 petrol benzol mixture freezes at about - 20° C; consequently, 60 per cent of benzol is about the greatest concentration permissible This limits the Highest Useful Compression Ratio (H.U.C R.) of an

aero-engine to below 7 1; hence there is a distinct loss of possible efficiency Diisobutylene or diamylene, having better anti knock properties than benzol, could permit of a higher H U C.R, and, moreover, blends of these hydrocarbons would not be liable to freeze at high altitudes, both substances being liquid at − 45° C. in an undiluted state Diisobutylene may be conveniently prepared by the polymerisation of the isobutylene content of 'cracked' gases by means of sulphuric acid, while diamylene may be obtained by the similar treatment of either trimethyl ethylene or tertiary amyl alcohol

Since this work was completed it has been found that E P 253,131 covers the use of these two olefines, among others, as anti knock dopes, and describes them as being better than benzol for this purpose, but no comparative figures are quoted

It is interesting to note that of the olefines we have tested, those which are the more stable towards bromine, sulphuric acid, potassium permanganate, and potassium bichromate, are the more effective in suppressing knocking

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A Permeability Test with Radioactive Indicators

CERTAIN investigators (see, for example, W J V Osterhout, "Some Fundamental Problems in Cellular Physiology," 1927, especially pages 36 48) believe that the protoplasm of the living cell is permeable only to undissociated molecules but impermeable to ions

It seemed possible to me to test this theory with the method of radioactive indicators [1] (Hevesy Paneth) The advantage of this method is that only very small amounts of the ions which enter the cell are necessary and that a very small concentration can be detected Radioactive lead (thorium B) was used as an indicator for lead ions, and therefore lead nitrate was dissolved in sea water so as to make it 10^{-5}–10^{-6} M in respect to lead ions Cells of *Valonia macrophysa* were used since the large volume and the amount of sap available make the investigation easier, and since investigations of the permeability of this cell were carried out by Osterhout and his collaborators

To test whether or not the presence of lead causes any injury to the cell, the cells were placed in sea water with different amounts of lead nitrate added, and for several months the behaviour of the cells observed The cells did not change in colour or rigidity, and were, according to Dr L R Blinks, who kept them in the same laboratory with other cells, in a normal state, judged from macroscopic appearance

For the permeability experiments, the cells were placed in sea water containing a known amount of lead nitrate and thorium B After 20 or 30 hours the cells were taken out, washed off with inactive sea water, and dried on blotting paper. The sap was removed, a certain amount (0 2–0 3 c c) evaporated in a watch glass, and the radioactivity measured in an α-ray electroscope The activity of the same amount of the original solution and of the sea water in which the cells were kept was measured. In this way we ascertained how much lead is absorbed by the cell wall and how much enters the vacuole In all experiments (14 cells) it was found that about 50 per cent of the lead ions present in the original solutions are absorbed by the cell wall, but that practically no lead enters the vacuole [2] The same experiments were carried out with cells which had been kept in sea water plus lead nitrate for four months Also in this case no lead could be found in the vacuole

One may conclude that all the lead which disappears from the sea water is adsorbed by the cell wall or the protoplasm forming an insoluble compound which cannot enter the vacuole In this case one would expect that in dead cells also the lead would be fixed at the cell walls and therefore cannot be found in the sap Experiments with three dead cells have shown that lead does enter a dead cell It is apparently fixed there to small particles of organic matter which are to be found always in dead cells Therefore it cannot diffuse back into the surrounding sea water and *an apparent concentration* of lead in the dead cells takes place

It was interesting to see whether radium emanation, being a rare gas, would enter the cells, as one would expect from the theory Small capillaries (16 mm long), filled with radium emanation (about 0 01 mc), were broken under the sea water containing the cells to be tested It was found that already after one hour the sap is approximately as active as the surrounding sea water (15 cells were investigated)

After every experiment, Dr L R Blinks examined the macroscopic appearance of the cells and tested the sap for sulphate ions (The presence of sulphate ions would indicate a severe injury) Part of the sap in our lead experiments and the sap of every single cell in the experiments with radium emanation was tested in this way Injury was found in one cell out of a total of three, exposed for 20 hours in radium emanation, and traces of sulphate ions in two cases out of twelve, after 1 to 2 hours exposure in radium emanation One cell that had been in lead nitrate for four months was soft, but did not give any sulphate reaction and did not show any sign of injury in our test

Summary —Using radioactive indicators for testing the permeability of single cells of *Valonia macrophysa*, it was found that lead ions do not enter the sap of the living cell even if the cells are kept for several months in lead nitrate solution Lead ions enter readily the sap of dead cells Radium emanation, being a rare gas, is already after one hour distributed evenly between the cell sap of living cells and the surrounding sea water

This investigation was carried out in the spring of 1927 during our stay at the Rockefeller Institute for Medical Research, New York City, and we are indebted to the International Education Board who made our stay at the Rockefeller Institute possible

KARL LARK HOROVITZ
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[1] That is to determine the amount of ions present, of a certain kind, by the determination of the radioactive isotope mixed with them. Since a chemical separation of isotopes is impossible, the change in activity of the radioactive isotopes is the indicator for changes in the concentration of the inactive ion.

[2] A trace of activity which was found twice immediately after drying is due to traces of thorium-C This may have entered the cell in ionic form, but since thorium-C is present only in an extremely small concentration, this is not contradictory to any other experiment on permeability Such a small amount may possibly also enter in other cases, but could not be detected On the other hand thorium-C shows in neutral solutions a quasi-colloidal behaviour and may have entered the cell in form of an undissociated complex

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Molecular Constants of Hydrogen

ONE of us recently published a table of constants for the neutral hydrogen molecule (*Proc Nat Acad Sci*, 14, 12, 1928) The most uncertain quantity in that table was the value of the moment of inertia for the 'B' level The value given ($1\ 99 \times 10^{-40}$) is based on Hori's very doubtful interpretation of Witmer's band progression $B_2 A_n$ We have now photographed the entire B A system in the second order of a ten-foot vacuum spectrograph, designed by Prof J J Hopfield

and constructed in the shop of this laboratory The new plates show clearly that the bands of the *B-A* system, originally analysed by Dieke and Hopfield, consist of *R* and *P* branches only, in contrast to Hori's assumption of an *R* branch plus coincident *P* and *Q* branches On this new interpretation a complete verification of the combination principle has been obtained. The lines show clearly the alternating intensity to be expected for a symmetrical molecule

While this work was in progress there appeared an article by Kemble and Guillemin (*Proc Nat Acad Sci*, **14**, 782, 1928), in which they conclude, on theoretical grounds, that the *B A* bands must consist of *R* and *P* branches only Using the published data of Dieke and Hopfield (*Phys Rev*, **30**, 400, 1927) and of Witmer (*Phys Rev*, **28**, 1223, 1926), they then calculated, on this interpretation, a moment of inertia for the *B* level of $1\ 51 \times 10^{-40}$ Because of the incompleteness and relative inaccuracy of the data, no great accuracy is to be expected for this value

Our own data are far more complete and accurate, the lines having been measured directly against first order iron standards The spacing of the rotational levels (values of ΔF) for the band progression $B_0 A_n$ fulfils accurately the expected relations between the vibrational and rotational energy constants Hence it is possible to obtain a very trustworthy value of the moment of inertia Using the best analytic method now known, we obtain on the basis of the old quantum mechanics, for the zero vibrational level of the *B* state, $B_0 = 19\ 46 \pm 0\ 04$, giving with the usual constants, $I_0 = (1\ 423 \pm 0\ 003) \times 10^{-40}$ gm cm ^{2} The rotational energy is given by $B_0 hm^2 + D_0 hm^4 +$, with m a half integer to within about 0 005 In obtaining the calculated value of $D_0 (= -4B_0{}^3/\omega_0{}^2)$ we used $\omega_0 = 1330$ cm $^{-1}$, derived by us from the recent accurate data of Richardson and Davidson (NATURE, **121**, 1018, 1928), in place of the value 1325 given in the table previously mentioned Analysis of the higher vibrational levels of the *B* state is in progress

H H HYMAN
R T BIRGE

University of California,
Jan 1

Homing of an Owl

THE following authentic case of the homing of an owl is of general interest in connexion with the fascinating, but often very baffling, problem of how animals find their way about

A pair of Cape barn owls (*Strix flammea maculata* Brehm) had taken up their abode in the roof of the verandah of the homestead of Mr F C Pope Ellis in Natal (Ashburton, altitude 2302 ft), and one of the fledglings was reared by hand One of the wings was afterwards partially clipped, and this prevented any great power of flight The bird was free, but was quite tame, it was fed regularly by hand and never appeared to go far from the homestead With the clipped wing the bird was unable to fly more than about fifty yards without alighting, and it was never seen to fly to any appreciable height in the air It retired at will to a sheltering box provided for it

At the age of seven months the owl was taken (Dec 3, 1928, at 9 A M) in a closed box by motor car to another farmstead (Cotswold, altitude 4807 ft) which is distant about sixty miles from the first mentioned farm. In its new quarters the bird remained for four days and then disappeared. Eight days later, at 6 A M , it was found in its shelter at its original home and in a perfectly placid condition

Thus in eight days the young bird, with weak powers of flight owing to its cut wing, travelled sixty miles over hilly and much broken country, including both bush and veld How did the bird find its way back ?

We cannot invoke racial memory as in the case of a fixed annual migration to a distant land Apparently the only other alternatives are (1) that in its original home the bird had acquired a general knowledge of the major distant features of the landscape and was led back by such clues, or (2) that it was conducted back by certain orientating influences, the nature of which we can only dimly surmise

The tendency at the present time is to deny the existence of these obscure directing influences in the homing of animals, and in the case of pigeons, bees, etc, it seems to be experimentally proved that the ability to return depends mainly on the recognition of clues in the surroundings which show the way home

The existence of recondite influences which are capable of directing movement is, however, evidenced by the assembling of male moths around the female, and it is extremely probable that the meeting of the sexes in many animals is largely affected by analogous influences

ERNEST WARREN

Natal Museum,
Pietermaritzburg

Anomalous Magnetic Rotation of Excited Neon

IN a paper on the anomalous magnetic rotation in excited neon (*Phys Rev*, **32**, 681, 1928), I published values of the dispersion constants determined from the anomalous rotation which were erroneous Due to the omission of the factor $\pi/180$ from the numerical part of equ (4) of that paper, the values of the dispersion constants given are much larger than they should be If this factor is included, the values so found are considerably smaller than those of Kopferman and Ladenburg, instead of much larger This result is also more in accordance with what one might expect from their work on the effect of the different conditions of excitation on the anomalous dispersion. The pressure in the tube and the exciting current used by me were both such as to give results considerably below the maximum, whereas the values of Kopferman and Ladenburg are saturation values

The corrected values for each wave-length are given below in the second column, in comparison with those of Kopferman and Ladenburg in the third column

6266	$0\ 55 \times 10^{11}$	$2\ 15 \times 10^{11}$
6532	0·34	1 36
6163	0 31	1 32
6506	$0\ 75 \times 10^{11}$	$3\ 38 \times 10^{11}$
6382	0 60	2 45
6096	0 44	2 15
6074	0 29	1 40
6304	0 22	0 9
6029	0 24	-0 6
6402	$3\ 06 \times 10^{11}$	$7\ 25 \times 10^{11}$
6143	1 14	2 16
6334	0 97	3 26
5944	0 58	1 59
6217	0 34	0 9
5881	0 35	1 0
5975	0 28	-0 5

R N JONES.

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The Raman Effect with Hydrochloric Acid Gas: the 'Missing Line.'

I HAVE obtained lines of modified wave length by the excitation of hydrochloric acid gas at atmospheric pressure, by the light of a glass Cooper Hewitt lamp about five feet in length, placed parallel to and in contact with the tube containing the HCl, the whole being completely surrounded by a cylindrical reflector of very highly polished aluminium, which was in contact with the two glass tubes Under these conditions the temperature of the gas was about 100° C, as indicated by a thermometer introduced into the metal cylinder

With an exposure of only twenty-four hours, and a Hilger constant deviation spectroscope, I obtained a very sharp and distinct line nearly midway between the mercury lines 4358 and 4916 It was almost in coincidence with the argon line 4579 (used as a comparison spectrum) Considering this line as excited by the mercury line 4046, the frequency difference between the exciting line and the modified line ($\lambda = 4581$) corresponds to the frequency in the infra red which would represent a line at 3 47 μ, almost exactly the centre of the vibration rotation band The line thus appears to be the so called 'missing line,' corresponding to a vibration transition unaccompanied by change of rotation, which does not appear in the absorption spectrum of the gas

The first photograph which I obtained showed a double line, namely, the 'missing line' and the first vibration rotation line next to it In this case the tubes were not completely surrounded by reflectors and the temperature was lower, the tube may also have contained some air and a trace of moisture This point is under investigation In my last photograph, I find also six lines immediately on the long wave length side of 4358, but have not yet determined whether they represent a part of the infra red band or are due to interference produced by the thin glass of the bulb As they appear on one side only of 4358, I feel sure that they are real R W WOOD

Magnetic Properties in Relation to Chemical Constitution.

IN the recent letter by Prof Lowry and Mr Gilbert (NATURE, Jan 19, p 85) some interesting points are dealt with concerning the evidence afforded by magnetic data as to the chemical constitution of various compounds The authors note that the fact that cupric sulphide, CuS, is diamagnetic suggests that this compound must be a cuprous compound with a double molecule rather than a cupric salt as previously supposed They also mention that X-ray analysis has shown that iron pyrites must be a ferrous disulphide, $Fe^{++}S\ S$

Magnetic measurements can furnish further information as to the chemical constitution of the latter compound. The magnetic properties of the cubic crystals of the type represented by iron pyrites, FeS_2, cobaltite, CoAsS, etc, were recently investigated The case of iron pyrites may be taken as typical It was found that after allowing for the diamagnetic properties of the sulphur atoms, the iron atom possessed a small residual positive magnetic moment, and the susceptibility was independent of the temperature These properties are in agreement with what would be expected for a twofold co ordination compound of *ferrous* iron, but are quite different from those of simple ferrous salts The Fe^{++} ion in iron pyrites must therefore have a constitution corresponding to that of the iron atom in, say, potassium ferrocyanide, and not to that of the iron atom in, say, ferrous sulphate

We must therefore classify these minerals, of which iron pyrites is typical, as co-ordination compounds Incidentally, their properties are in agreement with Cabrera's scheme for the relation between constitution and magnetic properties in co-ordination compounds, but the above conclusions are independent of the view taken as to the arrangement of the electrons in such compounds L C JACKSON

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Energies of Dissociation of Cadmium and Zinc Molecules

THE 2288 ($1^1S - 2^1P$) absorption line of cadmium broadens symmetrically with pressure until it reaches a sharp limit at the 2212 cadmium absorption band, but reaches no definite limit on the long wave-length side. In the electrodeless discharge in cadmium vapour, the 2288 line is surrounded by a continuous spectrum corresponding to the broad band found in absorption, but the limiting band at 2212 does not appear

These facts can be correlated with a pair of potential energy curves for the cadmium molecule, and from these curves the energy of dissociation of Cd_2 can be found The limiting band at 2212 is correlated with the transition of an electron from the non-vibrating 'grund' state of Cd_2 to the 2^1P level of the cadmium atom, that is, to the limit of the vibrational levels of the excited molecule The transition from the limit of the vibrational levels of the normal state to the limit of the vibrational levels of the excited molecule is an atomic transition which in the present case is $1^1S - 2^1P$ ($\lambda 2288$) Therefore the difference in energy between the limiting band at 2212 and the atomic line at 2288 gives the energy of dissociation of the normal Cd_2 molecule This equals 0 200 volt for Cd_2 and 0 246 volt for Zn_2

The full report of this work, which was done in Palmer Laboratory, Princeton University, will appear in the *Philosophical Magazine*

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(U S National Research Fellow)
University of Göttingen

Piles of Pebbles on Beaches

IN a letter published in NATURE of Dec 1, a correspondent directs attention to the occurrence of regularly spaced groups of pebbles along a beach in the New Hebrides, separated by patches of sand devoid of pebbles I may say that a similar occurrence is frequently to be observed on the beach in Bournemouth Bay to the west of Alum Chine, where the piles of stones collect at distances of from 15 to 25 yards between centres, to a height of one or two feet, and appear to contain all sizes indiscriminately between ¼ in and 4 in The regularity of the spacing along the water's edge can be well observed from the cliffs above

The action of the tides and wind in this part is such as to cause frequent changes in the nature of the beach, both in position of normal high-water mark and in the *slope* of the beach, and the occurrence of the regular spacings is therefore apparently haphazard

It might be suggested that when the slope of the beach bears a certain relation to the mean distance between waves, to the angle of incidence, and to the mean quantity of water in each wave, then the time of return of each exhausted wave may be in agreement with, or bear some integral relation to, the time interval between waves It would then seem possible for a regular condition to arise which might cause the observed facts R M CLARK

Municipal College, Bournemouth

Einstein's Field-Theory[1]

By Prof A S EDDINGTON, F R S

THE new 'Unified Field Theory' of Einstein is contained in two papers amounting altogether to eleven pages in the Berlin *Sitzungsberichte*, **17**, 1928, and **1**, 1929 There is an intermediate paper which does not concern us, since it follows a line of development now abandoned For the present, at any rate, a non-mathematical explanation is out of the question, and in any case would miss the main purpose of the theory, which is to weld a number of laws into a mathematical expression of formal simplicity We are chiefly interested in how it compares, both as to methods and results, with the existing field theories which have had some measure of success

Each attempt to unify gravitation and electromagnetism has been associated with what may be called an 'illustrative' geometry or world geometry A qualifying adjective is necessary, because I think it is now common ground that the actual geometry (obeyed by measured lengths, angles, etc) is Riemannian Einstein's world geometry may be briefly described as a geometry in which there are *parallels* but not *parallelograms* Thus he admits the existence, even at great distances, of a line CD equal and parallel to AB, but the line through B parallel to AC fails to cut CD (We are dealing with at least three dimensions, so that lines are not necessarily coplanar) The geometrical idea of an abortive parallelogram, which fails to close up at its fourth corner, does not carry us very far, and it is necessary to proceed analytically The following is a modified and shortened version which, I think, is equivalent to the original analysis

We take a general system of co ordinates x_μ with a Riemannian metric given by $g_{\mu\nu}$, and also in each small region a local system of co-ordinates x'_s which are orthogonal and have a Euclidean metric so that $g'_{st} = \delta_{st}$ These systems are connected by vector transformation formulæ

$$dx_\mu = h_s{}^\mu dx'_s \qquad dx'_s = h_\mu{}^s dx_\mu \qquad (1a, b)$$

The coefficients h are functions of the co-ordinates, and the symbol denotes a different (but related) set of functions according as the Greek or Latin suffix is uppermost It is not supposed that (1*b*) is integrable, that is to say, the co ordinates x'_s are not determinate, but only their differentials dx'_s By the law of tensor transformation

$$g^{\mu\nu} = h_s{}^\mu h_t{}^\nu g'^{st} = h_s{}^\mu h_t{}^\nu \delta^{st} = h_s{}^\mu h_s{}^\nu \qquad (2)$$

Also, if we displace a vector A'^s so that its components in local co ordinates are constant, that is, if $\partial A'^s/\partial x_\sigma = 0$, we have

$$\frac{\partial A^\mu}{\partial x_\sigma} = \frac{\partial}{\partial x_\sigma}(h_s{}^\mu A'^s) = A'^s \frac{\partial h_s{}^\mu}{\partial x_\sigma} = A^\epsilon h_\epsilon{}^s \frac{\partial h_s{}^\mu}{\partial x_\sigma}$$

by using the transformation law of contravariant vectors (1) This result is written

$$\frac{\partial A^\mu}{\partial x_\sigma} + \Gamma^\mu_{\epsilon\sigma} A^\epsilon = 0, \qquad (3)$$

with

$$\Gamma^\mu_{\epsilon\sigma} = -h_\epsilon{}^s(\partial h_s{}^\mu/\partial x_\sigma) \qquad (4)$$

As already stated, Einstein's geometry admits that up to any distance there can exist equal and parallel vectors, or (to use a less arbitrary description) vectors in one to one correspondence The purpose of the local co-ordinates is to indicate this correspondence directly, the components A'^s of two such vectors having equal values Equation (3) then indicates how to move a vector about in space without varying A'^s, and therefore remaining equal and parallel to itself Einstein's geometry postulates that the parallelism is unique and independent of the route of transfer, accordingly (3) must be integrable

The general idea is that the nature of the field can be completely described by specifying the values of the 16 quantities $h_s{}^\mu$ at every point Such a description is more comprehensive than if the 10 quantities $g^{\mu\nu}$ required to define the gravitational field are specified, so that it is able to embrace the electromagnetic field in addition The gravitational field is determined immediately from the h's by (2), they also furnish the quantities Γ by (4) Einstein sets $\Lambda^\mu_{\epsilon\sigma} = \Gamma^\mu_{\epsilon\sigma} - \Gamma^\mu_{\sigma\epsilon}$, and identifies the electromagnetic potentials with the four quantities $\Lambda^\epsilon_{\epsilon\sigma}$

We are now in a position to see the manner in which the present theory deviates from existing unified field-theories I make the comparison with the affine field-theory which I gave in 1921,[2] it was used by Einstein in 1923 as the basis of one of his former researches on this problem The affine theory also rests on equation (3), but does not limit Γ to the special form (4), on the other hand, it makes the limitation $\Gamma^\mu_{\epsilon\sigma} = \Gamma^\mu_{\sigma\epsilon}$, which is by no means implied by (4)

The complete contrast of the two theories which have equation (3) in common is rather remarkable

(1) In Einstein's theory equation (3) is integrable, in the affine theory it is essential that it should be non integrable

(2) In the affine theory $\Gamma^\mu_{\epsilon\sigma} = \Gamma^\mu_{\sigma\epsilon}$, in Einstein's theory it is essential that they should be unequal

(3) The curvature tensor $({}^*B^\epsilon_{\mu\nu\sigma})$ which provides all the gravitational and electrical field-variables on the affine theory, vanishes identically in Einstein's geometry, the expression $\Lambda^\mu_{\epsilon\sigma}$ which provides all the gravitational and electrical field-variables on Einstein's theory, vanishes identically in affine geometry

It has of course been realised that an extension of affine geometry with non-vanishing $\Lambda^\mu_{\epsilon\sigma}$ is possible This has been developed mathematically by Schouten and others, but no particular physical application has resulted The fact is that such an

[1] "Zur einheitlichen Feldtheorie Von A Einstein (Sonderabdruck aus den *Sitzungsberichten der Preussischen Akademie der Wissenschaften*, Phys.-Math. Klasse, 1929, 1.) Pp. 8. (Berlin Walter de Gruyter und Co., 1929.) 1 gold mark.

[2] *Proc Roy Soc*, **99**, p 104. I have followed this theory in "The Nature of the Physical World,' chap. vii. and xi

extension provides far more mathematical variables than the physicist can utilise Einstein's development is more promising, since he boldly accompanies this extension with a restriction, and room is made for the new variables by sweeping away old ones Moreover, he renders his restriction plausible by putting it in the form of a geometrical postulate of distant-parallelism

It will thus be seen that Einstein makes a striking new departure, the rest of the development may be briefly summarised The condition for integrability of (3), namely, the vanishing of the curvature tensor, leads to two important identities satisfied by the $\Lambda^{\alpha}_{\mu\nu}$ This rather raises an expectation in the reader's mind that the field laws are about to appear as identities, but this is not fulfilled A field law of simple form is duly announced, looking indeed so much like one of the identities that it requires a careful inspection of the suffixes to see the distinction Here I would venture on a criticism Can any theory which requires field laws other than identities give real satisfaction? To introduce a field law limiting the geometrical possibilities is a confession that the initial geometry was too wide The ideal should surely be either to start with a geometry which precisely fits the phenomena so that it needs no supplementary field laws, or to start with the most unrestricted geometry and treat every limitation as a field law

The consequences of the field law are worked out only to a first approximation and therefore some of the questions we should wish to put remain unanswered "A fuller investigation will have to show whether a Riemann-metric in conjunction with distant-parallelism actually gives an adequate conception of the physical qualities of space According to this research it is not improbable"

In any comparison of these theories it should be borne in mind that what is being given is a graphical representation bound by no particular rules To say that Einstein's or Weyl's or Eddington's illustrative geometry is the only right one would be like saying that a graph of a moving particle with time and space as co ordinates is right but a graph with velocity and curvature as co ordinates is wrong World geometry is very like other graphs, if wisely chosen it may exhibit or suggest relationships, provide useful nomenclature, and generally assist the mind in orderly thought More hazardously it may be supposed to shadow the structure of the substratum of physical phenomena I do not think Einstein has this last aspect in mind, or he would have stressed the vanishing of the curvature tensor (which might be visualised as a structural attribute of the æther) rather than the formal property of distant parallelism I take it that he commends his graph to our notice as a means of exhibiting in its simplest form the mutual interdependence of gravitational and electrical quantities For my own part I cannot readily give up the affine picture, where gravitational and electrical quantities supplement one another as belonging respectively to the symmetrical and antisymmetrical features of world measurement, it is difficult to imagine a neater kind of dovetailing Perhaps one who believes that Weyl's theory and its affine generalisation afford considerable enlightenment, may be excused for doubting whether the new theory offers sufficient inducement to make an exchange

Human Speech [1]

By Sir RICHARD PAGET, Bart

HUMAN speech—which is practised by all races of mankind—is a rough combination of two separate arts, namely, phonation, due to the reed like action of the vocal cords, and articulation, due to the various movements of the jaw, lips, tongue, soft palate, epiglottis, and false vocal cords Phonation is the language of the emotions, while articulation is the language of the mind—phonation being, as Darwin realised, the older art

The mechanism of the vocal cords may be very simply imitated by cutting a longitudinal slit about 3 cm long in an indiarubber tube of, say, 1 cm internal diameter If the tube be stopped at about 5 cm from the slit, and air be blown in at the other end, the air passing through the slit may be set in vibration so as to produce a musical note The conditions for this effect are most easily obtained by adjusting the resonance of the air inside the tube adjoining the slit—by varying the position of a constriction or partial stop applied between the slit and the air supply At any position at which 'phonation' occurs under normal conditions of the slit, a musical range of about six or seven semitones can be obtained by varying the tension of the slit portion of the tube, the note rising as the tube is stretched As the resonating length is shortened (so as to raise the resonant pitch) the musical range is transposed to a higher key, the range of transposition in the present experiment being also about seven semitones

It is suggested that the so called 'registers' of the human voice are due to a similar set of conditions, and that the changes of resonance are produced by variation of the size and shape of the cavity into which the vocal cords 'deliver,' namely, that made by the false vocal cords and other movable parts of the pharynx At each setting of this cavity a new range of notes is then obtained, depending on the tension and thickness of the vocal cords

The lips of a trumpeter behave in a very similar way, but the resonance changes, if any, must then be made (as in the rubber-tube model) in the passage behind the reed instead of in the cavity into which it delivers, as in the case of the vocal cords

The lungs, besides functioning as bellows, are a very efficient sound absorber, the branching air

[1] Substance of two lectures delivered at the Royal Institution on Dec. 6 and 13, 1928.

passages and air cells acting like a shelving beach towards waves of the sea, to convert the sound waves that pass down the windpipe into heat

In whispered speech we have articulation without phonation Whispered speech, therefore, lacks the emotional range of voiced speech All the English speech sounds can be rendered in a whisper, and it appears that the real distinction between the so called voiced and unvoiced consonants, such as *b* and *p*, *v* and *f*, *dh* and *th*, *z* and *s*, etc, is due to the action of the false vocal cords

The action may be illustrated by a model in which the vocal cords are shaped in plasticene, as if in an open (whispering) position, and deliver their air jet into a rubber tube 2 5 cm in diameter, which acts as the pharynx of a vowel sounding tube If, while air is supplied to the model, its mouth is alternately obstructed and released by hand, a whispered *p* is heard when the pharynx tube is uncompressed, but the sound is changed to a whispered *b* if the pharynx tube is compressed so as to form a constriction at 2 to 3 cm in front of the fixed vocal cords These conclusions have been confirmed by direct observations made in America by Prof Oscar Russell, of Ohio University

Another recently observed action of the pharynx is its production of the high pitched resonances—of the order of 2500 3000~—which I have observed by ear in the case of certain of my own vowel sounds, and which have also been disclosed by instrumental methods at the Bell Telephone Laboratory in New York That these resonances (in my own case) are pharyngeal, is shown by the fact that they can be lowered in pitch by five or six semitones by external (transverse) pressure on the throat immediately above 'Adam's apple' They cannot be consciously varied without external aid It is evident that the pharynx plays a very large part in the process of articulation in modern speech

Originally, it is suggested, articulation was evolved as a specialised form of pantomimic body gesture, by which primitive man, like his animal relations, was accustomed to explain himself to his fellows Darwin, in "The Expression of the Emotions," pointed out that there is, in man, a natural sympathy of movement between the human jaw and tongue and the human hand, so that children learning to write are seen to twist about their tongues as their fingers move 'in a ridiculous fashion' As primitive man pantomimed with his hands and body generally, his tongue took part in the game without his being aware of the fact, and thus it developed a pantomimic technique of its own When the pantomimist wished to direct attention to his actions, he made grunting or blowing noises, and the (unconscious) movements of his tongue then modified the air flow and the acoustic resonances of the vocal cavities through which the air passed In this way the bodily pantomimic code became associated with an acoustic code, which developed into speech

The various tongue gestures were necessarily simpler and fewer in number than the corresponding hand gestures, since (as would be found by experience) lateral movements of tongue, lips, and jaw do not appreciably alter the vocal resonances The movements of articulation are therefore practically limited to two dimensions, whereas the hand and body gestures work in three It follows that in human speech a particular gesture of articulation may represent several originally different body gestures—in other words, that speech was always more ambiguous than the pantomimic sign language

The original pantomime and speech of primitive man may be conceived as analogous to the bodily pantomime which is naturally developed by deaf mutes, and by which a deaf mute of one country can without difficulty make himself understood by one of another country, of whose written and spoken language he is wholly ignorant Just as various communities of deaf-mutes naturally evolve new signs and conventions of their own—which other deaf mutes cannot understand until they have especially learnt them—so the tribes of primitive men may be imagined to have evolved local words, idioms, and conventions from which the various language groups of the world were developed

The theory that speech is due to mouth pantomime was, I believe, first enunciated by Dr J Rae, of Honolulu, in *The Polynesian* newspaper for 1862, but Socrates, according to Plato in the Cratylus, came very near the same idea, Dr A R Wallace, writing in 1895 in *The Fortnightly Review* (No 64), also put forward the theory that mouth pantomime constituted a "fundamental principle which has always been at work, both in the origin and in the successive modifications of human speech"

The evidence which has now been accumulated seems to justify a more serious consideration than has yet been given to the theory Thus it appears, on experimental grounds, that in listening to speech our ears are not primarily interested in the sounds themselves, but rather in the evidence which the sounds afford as to the postures or gestures of the tongue and other organs of articulation The facility with which the deaf may be taught to understand speech by 'lip reading,' in spite of the very limited information which sight alone can afford as to the movements going on inside the mouth and throat, points in the same direction Children, when inventing words of their own, very commonly employ a form of mouth pantomime—thus, of 18 such words mentioned by Prof O Jespersen at p 152 of his book on 'Language," 12 appear to be pantomimic for example, fu wε = soap—a gesture of blowing away soapsuds, dε dεtsh = horse—a galloping gesture made with the tongue

Grown-up people occasionally do the same—as witness the invention of the word 'blimp' to denote the small podgy dirigible balloons which were developed during the War The word is produced by a small mouth gesture (producing the sound *bi*) followed by the 'podgy' gesture *mp*, with an intermediate upward flick of the tongue, *l* (as if to suggest an attachment to the middle of the 'bimp'), which completes the word—'blimp'

Arguments of this kind seem at first sight fantastic, but it must be remembered that in the

evolution of speech we are dealing with a product of man's subconscious mind—" such stuff as dreams are made of "—and that it is no more strange that our speech symbolism should be fanciful than that our dreams should be so. For flights of fancy we come into life fully fledged—but we moult early or are plucked in the course of our education, and we come to despise the arts of imaginative flight at which our distant ancestors were such adepts.

There are other ways of testing the theory. We may invent 'synthetic' words by making (consciously) a pantomimic gesture with our tongue, or tongue and lips, and convert it into speech by grunting as we make the gesture. Of 19 such words, 18 were identified by Dr. Neville Whymant as actually occurring with the same meaning, and in the same or a phonetically allied form, in Polynesian, early Japanese, Indo-Chinese, or related languages. Thus, the tongue symbolising "to dance up and down to and fro" produced the synthetic word *li lo* (lee-law). Dr. Whymant cited the Indo-Chinese words 'li lo' and 'li lü,' meaning to dance; Prof. Louis Gray, of Columbia, cites the Sanscrit word 'lila,' meaning game or enjoyment; to these I would add the English word 'lulla-by,' meaning to 'dance (a child) up and down, to and fro' in order to put it to sleep.

It is evident that if the pantomimic theory is true, it should appear (more or less) in all languages; a preliminary study has therefore been made of several 'unrelated' language groups, namely, Indo-European, archaic Chinese, Sumerian (as written at Ur of the Chaldees), Semitic, Polynesian and allied languages and the Hoka languages of the west coast of North America. In all of these, pantomimic words are found to be common. Thus, of the first 100 'Aryan roots' listed in Skeat's 'Etymological Dictionary,' 77 were found to be pantomimic, 12 were probably pantomimic, and only 11 showed no evidence. In Karlgren's "Analytic Dictionary of Archaic Chinese," 85 per cent of the 73 word groups listed in the first twenty pages showed pantomimic structure, while in a list of comparable Polynesian and allied words, and Hoka words, published by Paul Rivet (" Les Malayo-Polynésiens en Amérique "), 86 per cent of the word groups showed the same principle.

Many words are common to each of these groups; thus, in all of them the word for *one* is made by an erect tongue gesture—symbolic of the index finger held up. Thus, Indo-European has 'oin,' archaic Chinese has 'iet,' Sumerian has 'aś' (compare with our word 'ace'), Semitic has 'ahad,' Polynesian has 'ta,' Hoka has 'ta,' 'tsâ,' 'cha,' and forms like 'pun' and 'pola.' In all of these the characteristic gesture is an erection of the tongue. A similar analogy is found in the case of the numerals *two* (made by a protrusion of the two lips) and *three* (made by protruding the tongue between the two lips).

Figs. 1 and 2 show the approximate tongue positions which correspond with the various English vowels and consonants; from these it is possible to draw the approximate tongue track of any given word so as to compare the gesture with its verbal meaning. It then becomes apparent that the same gesture may be construed in several different ways. Thus the tongue track may represent a direction of motion, or the outline of a form—it may be

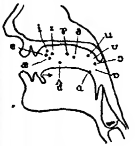

FIG. 1.

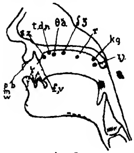

FIG. 2.

construed literally or figuratively—and finally, it may be significant at the beginning, middle, or end of its course. For example, the archaic Chinese word 'kân,' of which the tongue track is shown in Fig. 3, means 'dawn' (sun rising up) or the trunk of a tree (an up-swinging outline). Of figurative words may be instanced the Sumerian 'daria' or 'duria,' meaning 'eternity,' in which the tongue track (see Fig. 3) forms a closed figure very similar to that of the hand gesture which deaf-mutes make to-day to express the same idea.

As to the significance of different parts of the tongue track, a good example is the word 'al'—formed by an upward thrust of the tongue—which may mean (1) 'up' or 'high' (Latin 'altus'), or (2) 'slack,' 'weak,' 'relaxed,' or (3) 'sweet' that is, touching the palate as in tasting. In (1) the first part of the travel, in (2) the return journey, in (3) the mid portion is significant.

It follows that 'homophones' (words with two or more different meanings) are natural to human speech. It also follows from our theory that the many instances in which the same sound bears a similar meaning in (presumably) unrelated languages are not due to chance, but to a common method of production—if not actually to a common origin. It is not a matter of chance that in archaic Chinese 'ma' meant mother (a sucking gesture) and that it also meant 'leach' (one who sucks) or that 'kât' meant 'cut,' 'suk' meant 'suck,' 'pa' meant 'father,' 'k'âp' meant 'cup,' 'kap' meant 'cap' (of a seed or bud), and 'sieu' meant 'sew' (embroider); such coincidences are rather to be expected.

FIG. 3.

Surveying human speech, as a method of symbolising thought by gesture of the organs of articulation, we can scarcely escape the conclusion that it is still in a very barbaric and imperfect condition. It is full of ambiguities, anomalies, and homophones; it is cumbered (in most cases) by a quite unnecessary complexity of grammar and syntax; it mixes up voiced and unvoiced speech sounds with a corresponding loss in audibility, intelligibility, and musical and emotional quality.

The notation of language—especially in the case of English—is in worse case than the language itself, since in it our spelling now lags some centuries behind the spoken word It is of prime importance for the advancement of human thought that we should now prepare for the systematic improvement and purification of our own language, so as to make it a more perfect and artistic method of symbolism for our thoughts It is equally important that we should co ordinate our efforts with those of the other English speaking communities, so as to aim, in the future, at a standardised language and pronunciation with a rational spelling The development of world broadcasting will make unification comparatively easy

In the meantime we should ensure that our children are taught, in the first instance, to read and write phonetically, to articulate clearly, and to take an interest in the history and structure, the virtues and defects of our language, so that they may be prepared for the important task which lies before them

Obituary

Sir W Boyd Dawkins, F R S

By the death of Sir William Boyd Dawkins on Jan 15 at his residence, Richmond Lodge, Bowdon Cheshire the sciences of geology and archæology have alike lost one of their most outstanding personalities He was born on Dec 6 1837, at Buttington Vicarage Welshpool, and was therefore just over ninety two years of age at his decease He was the only son of the late Rev Richard Dawkins

Boyd Dawkins was educated at Rossall and at Jesus College, Oxford he won the (first) Baroness Burdett Coutts Scholarship and graduated first class in natural science in 1860 and second class in Classical Mods , and was the first undergraduate to take geology in the honours school Afterwards he became an honorary fellow of his College

On leaving Oxford Boyd Dawkins was given an appointment in 1861 as a field geologist on the staff of H M Geological Survey of Great Britain and was allotted to the unit then surveying the south eastern counties of England In 1869 he resigned to take the post of curator to the Manchester Museum and lecturer in Owens College He became professor of geology and palæontology in 1872 at the Victoria University, Manchester, and acted as a consultant on questions of mining and civil engineering involving geological problems This post he held until 1908, but after his resignation he occasionally gave lectures on geology as an honorary professor

Boyd Dawkins was not content to confine his researches to his own country, but was always keen on comparing the story of the rocks elsewhere, and so he travelled widely in North America and Australia during the long period, 1874–1890 It was on one of these visits that he gave his notable lecture at the Lowell Institute Boston, on ancient man

The discoveries by Boucher de Perthes of flints presumably worked by man in the valley of the Somme led to much controversy on both sides of the Channel, and was one of the contributory causes of the intensive search among the river gravels and cave deposits for reliquiæ of man A distinguished band of observers, including Evans, Lyell, Lubbock, Prestwich, and Boyd Dawkins attacked this problem, and as a result raised the study of archæology from its former position as an amusement for the dilettante to that of scientific philosophy

As a palæontologist Boyd Dawkins will always rank high, because he did not allow his conclusions to get beyond the region of legitimate inferences drawn from available evidences As an archæologist he preferred the field work of exploration to theorising about results in the museum and library, and he therefore was always sympathetic with other workers who were labouring under the disadvantages of imperfections of the geological record, but was rather impatient in later years with some who held advanced views as to classification

Boyd Dawkins' earliest work was his explorations of Wookey Hole, near Wells, in the Mendips one of the great limestone caverns which was occupied by Pleistocene beasts The fossil bones embedded in the cave breccias and cave earths were a source of inspiration that led him to make a critical examination of that and of other caves in different parts of England and the knowledge gained by the discoveries then made and also those in the gravels and brick earths of the river valleys was partly expressed in his classical monograph on the British Pleistocene Mammalia, published by the Palæontographical Society In this piece of research he co operated with the late W A Sandford His ' Cave Hunting" published in 1874 was dedicated to The Baroness Burdett Coutts as a slight acknowledgment from her first scholar ' In this volume he described and discussed the notable discoveries of human relics not only in the caverns of England, but also in those of Aquitaine Belgium, Switzerland, and other countries His conclusions as to the antiquity and sequence of the different races of Stone Age man expressed in this book, were more or less maintained to the last namely, that the hunting and fishing race of cave dwellers in the remote Pleistocene age in possession of France, Belgium Germany, and Britain were probably of the same stock as the Eskimos living and forming a part of a fauna in which northern and southern living and extinct species are strangely mingled with those now living in Europe

Boyd Dawkins followed up his attack on the problem of prehistoric man by detailed examination of the fluviatile deposits of the European rivers, and to prepare himself for the inquiry he visited the more important museums in France and Italy and some of those in Germany and Switzerland, where he became a welcome visitor and friend of the curators In the preface to his next work, "Early Man in Britain" (Macmillan, 1880), he acknowledges his debt to a number of geologists and archæologists who now rank among the fathers of the sciences, and include Sir Charles Lyell, Sir John Lubbock, Sir John

Evans, Dr Thurnam, and Profs Gaudry, Steenstrup, Capellini, Broca, Rütimeyer, and Virchow In this book Boyd Dawkins draws the important conclusion that "it is unlikely that man lived in Europe in the Pliocene age" but that "he appears just in the Pleistocene stage in the evolution of mammalian life in which he might be expected to appear" He divided palæolithic man into two great groups, river drift man and cave man, a classification which is accepted in a broad way to-day, but the differentiation into the several stages that has resulted from the researches of later observers he was never inclined to accept, he was not, indeed, willing even to accept the classification of de Mortillet without reserve "Early Man in Britain," however, is still in demand, and is an example of his extremely clear and logical presentation of facts, often of a highly technical nature, in such a way that the reader, while grasping the details, never loses sight of the main conclusions It is eminently a readable book and impresses one as the work of a master hand

Boyd Dawkins was never content to study geology as pure science only, for he applied himself to its industrial and commercial applications, and acted in the capacity of 'expert adviser' on numerous questions involving geological knowledge Like Prestwich, he devoted much time to the study of water supply to cities, and was consulted with regard to the schemes involved in those of London, Manchester, and Liverpool His knowledge of the geology of the areas where engineering works were contemplated was employed in the schemes for the Manchester Ship Canal and the Humber Tunnel, and he was entrusted with the survey of the English and French coasts when the question of the Channel tunnel came up in 1882 His civic work in Manchester is still highly prized As a result of his inferences, the search for coal in the concealed coal-field under Kent was largely undertaken, and his advice was often sought in working the Cheshire salt deposits

His work was early recognised by his election to the Royal Society in 1867, and in after years numerous honours were bestowed upon him The Geological Society of London, to which he was elected fellow in 1861, awarded him its Lyell medal in 1889, and very appropriately the Prestwich medal in 1918, he served on the council for four long sessions He received the degree of D Sc from Oxford in 1900 and from Manchester the Hon D Sc He was married twice, first in 1866 to Frances Evans (died 1921), by whom he had a daughter, and secondly in 1922 to Mary, widow of Mr Hubert Congreve

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Sir Henry Trueman Wood

The death of Sir Henry Trueman Wood on Jan 7, at eighty three years of age, removes from the intellectual and the administrative world a remarkable figure, who, in his prolonged years of great activity did much, indirectly, to shape the conditions under which many of us live Numerous notable persons, still living, and eminent in the manifold fields in which he laboured, will sincerely regret the disappearance of his well known tall and spare but distinguished figure, which is so well portrayed by Herkomer in his oil painting which hangs in the council room of the Royal Society of Arts, in the home which Robert Adam, one of the famous brother architects, built for the Society in 1774, in John Street, Adelphi Here he did much for the Society, as secretary, for thirty eight years, and was largely instrumental in bringing together a galaxy of talent which included Sir William Siemens, Sir Frederick Bramwell, Sir Frederick Abel, Sir Douglas Galton, Sir Richard Webster, Sir John Wolfe Barry, Sir William Preece, Sir William Abney, Lord Sanderson, and many others, all of whom were chairmen of the council during his secretaryship

Born in 1845, Sir Henry was educated at Harrow, and at Clare College, Cambridge, where he was a scholar and twice won the Le Bas prize for the best English essay on a subject of general literature On leaving the University he became a clerk in the Patent Office, where he acquired a knowledge of inventions which afterwards proved very useful to him and to others, while it enabled him to suggest very useful modifications in the patent laws which were dealt with by Parliament by a special Act in 1883 In 1872 he became editor of the *Journal of the Royal Society of Arts*, where, six years later, he became, in 1878, secretary, in which capacity he followed a so well known and eminent predecessor as Peter le Neve Foster, and where he occupied a seat which, more than a hundred years before, had been coveted by no less considerable a personality than Oliver Goldsmith, the author and poet

Before concluding this account of Sir Henry Wood's services to the Royal Society of Arts, there must not be omitted some reference to the history of the Society, which he wrote This was published by John Murray in 1913, and gives an illustrated and vivid account of the very varied activities of the Society from its inception in 1754, with references to the many eminent persons that were from time to time connected with it

On his retirement from the secretaryship Sir Henry Wood was elected a member of the council, and served as its chairman for the year 1919 20 Later, in recognition of his signal services, he was nominated, by H R H the Duke of Connaught, the president, to a vice-presidency, which he held up to his death, while at the same time members of the council raised a fund to provide an annual Trueman Wood lectureship, in connexion with which a number of brilliant addresses have been delivered by eminent men of science

Sir Henry Wood took a leading part in the inauguration and management of many and great exhibitions, where the knowledge of inventions that he had gained at the Patent Office proved to him invaluable Among these were the series of international shows started at South Kensington in 1871 by Sir Henry Cole, in close association with the Royal Society of Arts Sir Henry edited many of the reports of these exhibitions, and served in

various capacities in connexion with them, which included the Health Exhibition of 1884, the Inventions Exhibition of 1885, and the Colonial Exhibition of 1886

When it was proposed to hold an International Exhibition in Paris in 1889, the British Government declined co-operation owing to an objection by Queen Victoria, because the exhibition was to be a celebration of the taking of the Bastille in 1789, and of the French Revolution It was proposed that the Society of Arts should undertake the organisation, and the Prince of Wales at first consented, but afterwards withdrew his consent Eventually a committee was formed under Sir P de Keyser, the Lord Mayor of London, as chairman, and Sir Henry Trueman Wood as secretary The British section was successfully organised and carried through without Government aid, this being the first and only occasion on which the British section at a great international exhibition was established without Government funds On the conclusion of this successful exhibition, Sir Henry received the honour of British knighthood, and that of an Officer of the Legion of Honour from the French Government

In 1893 the council of the Royal Society of Arts was appointed a Royal Commission to administer a sum of £70,000 granted by the British Government to support a British Section at the Chicago Exhibition, and Sir Henry Wood went to Chicago and remained there throughout the holding of the Exhibition

Nor must there be forgotten the contributions that Sir Henry made to technical education In 1877 reports were asked for from him, as also from Prof Huxley, Sir John Donnelly, Sir Douglas Galton, Sir William Armstrong (afterwards the first Lord Armstrong), and Sir George Bartley, for formulating a scheme of technical education for the committee of the City Guilds, who had recently taken up the subject The suggestions of Sir Henry Wood were practically adopted, which led to his acting as secretary for some time to the committee of the City Companies

In 1878, Sir Henry became secretary to Section G (Engineering) of the British Association, and continued to hold this office for seven years

Sir Henry's interest in photography went back to wet collodion days, before the introduction of the dry plate He read papers on photography both before the Royal Photographic Society and the Camera Club, and became president of the former Society from 1894 until 1896, after having previously been several years on its council After this, it is perhaps not surprising to learn that for many years he served as a director on the board of Kodak, Limited, and until recently was chairman of the European section of that world-famous company For more than a quarter of a century he was a well-known member of the Athenæum Club, and served on the executive committee, of which, for several years, he was chairman

Amongst Sir Henry's other publications was a volume on "Industrial England in the Middle of the 18th Century", a volume on "Methods of Illustrating Books," which, for its date, was full of information, besides numerous articles in magazines and in the daily press Sir Henry leaves behind him a memory of a kindly but sagacious personality, with wide culture, both scientific and literary, and a record of unusual capacity and industry directed by a very sound judgment both as regards affairs and also concerning men

A A Campbell Swinton

Mr R H Cambage, C B E

By the death of Richard Hind Cambage, which took place suddenly on Nov 28, 1928, Australian science has lost one of its most prominent figures He was born at Milton, N S W, on Nov 7, 1859 Having been trained as a surveyor, he joined the public service in 1882, serving for three years as a draftsman in the Department of Lands He was then, in 1885, appointed mining surveyor in the Mines Department, and his duties in this position carried him to all parts of the State and gave him the opportunity of obtaining a wide field knowledge of the botany of the State In 1902 he became Chief Mining Surveyor, which position he held until he became Under Secretary for Mines on Jan 1, 1916 He retired from the public service on Nov 7, 1924, at the age of sixty five years He was a member of the Licensed Surveyors' Examination Board from 1903 until 1918, and also lecturer in surveying at the Sydney Technical College from 1909 until 1915 He was elected president of the Institute of Surveyors of New South Wales for three successive years, 1907–1909

In the work of scientific societies in Australia, Cambage was one of the recognised leaders, and at the time of his death he was president of the Australasian Association for the Advancement of Science and of the Australian National Research Council His wide and active interests are indicated by the offices he had held in scientific societies, amongst them being president of the Royal Society of New South Wales in 1912 and 1923, of the Linnean Society of New South Wales in 1924, of the Wild Life Preservation Society in 1913, and of the New South Wales Branch of the Australian Forest League in 1928 He was honorary secretary of the Australian National Research Council from 1919 until 1926, and one of the honorary secretaries of the Royal Society of New South Wales, 1914–1928 (except 1923 and 1924) As honorary secretary of the Australian National Research Council he did the lion's share of the organising work for the second Pan Pacific Science Congress held in Melbourne and Sydney in 1923 For several years he was also a trustee of the Australian Museum He was one of the few who are willing and able to shoulder the onerous duties inseparable from the successful management of scientific societies He was elected a fellow of the Linnean Society of London in 1904, and in 1905 was created C B E

Mr Cambage's scientific work was chiefly botanical and may be divided into three sections He had a very wide field knowledge of the Australian flora, and it may safely be said that there are few, if

any, botanists of the present century who have such a knowledge of the flora of a country so extensive as Australia He had special knowledge of the genera *Acacia* and *Eucalyptus*, and the endemic plant assemblages peculiar to the island continent He contributed to the *Proceedings of the Linnean Society of New South Wales* eighteen papers dealing with the local development of the flora in various districts Of the twenty nine papers he contributed to the *Journal of the Royal Society of New South Wales*, thirteen detailed his observations on the growth and development of *Acacia* seedlings This work he developed systematically and aimed at completing descriptions of the seedlings of ten species each year He had dealt with one hundred and thirty species in the papers already published, and, having discussed the commoner species, was beginning to find it more difficult to obtain well authenticated seeds of the more uncommon species Cambage was also keenly interested in the degree to which species of plants exhibited a preference for certain types of soil His general ideas on the subject were indicated in his presidential address to the Linnean Society of New South Wales in 1925 Another topic on which his many observations made him competent to speak with authority was that of the origin of the Australian flora, and this he developed in his address to the Australasian Association for the Advancement of Science at the Hobart meeting less than a year before his death

Keen interest in the earlier explorers resulted in some valuable contributions by Mr Cambage to the work of the Royal Australian Historical Society His knowledge of bushcraft, perfected by his experience in surveying, caused him to delight in attempting to follow, step by step, some of the journeys of the explorers, for he was scarcely ever so happy as when he had, from some random observation in an explorer's diary, been able to prove just where the explorer must have been when the entry was made

Mr Cambage was a personality that will be sadly missed in scientific circles on account of his high principles He possessed, to a rare degree, those qualities of tact, moderation, charitable judgment, and geniality which made him beloved by all his colleagues—many an awkward moment in the counsels of scientific societies has been safely negotiated by his tact Only once in many years have I known him seriously perturbed, and then, in his usual tactful way, he set out to overcome the source of his perturbation with such success that few indeed knew anything about it

A B Walkom

Mrs D H Scott

By the death of Victoria Henderina Scott, which took place quite suddenly at her home at Oakley, Hants, on Jan 18, the Linnean Society loses one of its earliest women fellows, and botany a keen and loyal supporter Mrs Scott was elected a fellow of the Linnean Society in February 1905, following the grant of the supplemental charter which removed the sex distinction Her active interest in the Society's work was illustrated by an exhibition, shortly after, of a series of animated photographs, taken by the kinematograph, showing opening and closing of flowers, and other plant movements Until recent years she was a frequent attendant at the meetings of the Society, and in 1911 gave a lantern exhibition of a new species of the fossil genus *Traquaria* Communications on plant fossils and other subjects were also contributed to the *New Phytologist* and the *Annals of Botany* In the preface to the second edition of the "Studies in Fossil Botany" (1909), Dr D H Scott acknowledges the help of his wife in the preparation of some of the illustrations, and a similar service had been rendered in his "Introduction to Structural Botany" (1894–96)

Mrs Scott also shared her husband's general botanical and scientific interests We recall the International Botanical Congress at Vienna in 1905, to which they were delegates, the annual meetings of the British Association, where they were supporters of Section K, and of the South-Eastern Union of Scientific Societies, of which Dr Scott has been president, in addition to the various activities of scientific societies and other functions in which they participated Many botanists, at home and overseas, will recall the gracious hospitality of Dr and Mrs Scott at their charming home in Hampshire, and the interesting garden which Mrs Scott loved to show to her guests She will be greatly missed, and not in botanical circles only, for she had wide interests

Dr William John Bowis, whose death occurred on Jan 25, was born in Nottingham in 1881, and entered the employment of Sir Jesse Boot in 1897, being engaged in the firm's analytical laboratories From 1903 until 1905 he worked under Prof A Werner at the University of Zurich, and took part in Werner's researches on the co ordination compounds of cobalt, receiving the Ph D degree in 1905 He afterwards returned to industrial work, and was largely responsible for the development of the soap and perfumery business of Messrs Boots Pure Drug Co , Ltd , of which he became a director in March 1909 During the War he took a large part in organising the production of gas masks in Messrs Boots' factories, and was made an O B E in 1919 Dr Bowis was a man of great ability and genial disposition, and the loss created by his death will be greatly felt

We regret to announce the following deaths

Mr T H Blakesley, for several years honorary secretary of the Physical Society of London, on Feb 13, aged eighty one years

Dr J E Eddison, emeritus professor of medicine in the University of Leeds and a former president of the Leeds Literary and Philosophical Society, on Jan 27, aged eighty six years

Mr Victor Plarr, librarian of the Royal College of Surgeons of England, Lincoln's Inn Fields, London, since 1897, on Jan 28, aged sixty five years

Sir Bertram Windle, F R S , professor of anthropology in St Michael's College, University of Toronto, on Feb 14, aged seventy years

News and Views.

DRAYSON's astronomical conclusions, and their bearing on the ice age, formed the subject of a lecture by Lieut Col T C Skinner at the Victoria Institute, on Feb 18 Col Skinner postulated that in 13,548 B C the obliquity of the ecliptic was about 35½°, 12° more than at present, and assumed that this alone would suffice to cause an ice age Quite apart from the astronomy, however, the meteorological inference is far from being self evident At present the winter climate of north west Europe does not depend appreciably on the altitude of the sun, it is dominated by south west winds from the Atlantic, and temperature is almost uniform from Ireland to the north of Norway The south west winds depend on the existence of an area of low pressure near Iceland, and the position of this Icelandic 'low' results solely from geographical factors It does not change from winter to summer, so that there is no reason to suppose that a greater obliquity would displace it It might be argued that a greater obliquity would make our winters more 'wintry', that would simply mean that the Icelandic 'low' would become more intense Our climate would be stormier, but no colder, our rainfall would increase, but not our snowfall

THE solar control of our climate is already so small in winter that a further decrease would scarcely be noticeable Any changes which might result in the winter climate of the coast would be offset by the greater power of the sun in summer, and Antevs has shown that a cool summer is more important for glaciation than a cold winter On all counts one cannot but think that changes of the obliquity are inadequate to cause ice ages Drayson's theory has the further consequence that for several thousand years the contrast of temperature between winter and summer should have been decreasing, and historical data are adduced in support of this The historical data do not, however, furnish such a proof, there is not the slightest evidence that the contrast in Roman times was greater than it is now Even in the post glacial period, though there have been fluctuations, there is no trace of a progressive decrease in the annual range Satisfactory support for Drayson's views is not forthcoming, therefore, from meteorology

IN his address on the coming of age of the Eugenics Society, delivered at the Galton dinner on Saturday, Feb 16, Major Leonard Darwin, who last year retired, after seventeen years, from the presidency of the Society, surveyed the changes which have taken place in the field of eugenics during his tenure of office The most remarkable change has been the great advance in public opinion towards the recognition of the need for and practicability of eugenic reforms Natural inheritance and the transmission of human qualities by means of tradition, though radically different processes, are often so alike in their results that the social policy to be advocated ought to be the same whichever of the two is regarded as the more important The son of a criminal is ten times as likely to be a criminal as is the son of honest parents, and whatever is the actual cause of the fact, it follows that to reduce the fertility of criminals would confer a benefit at which all social reformers ought to aim The fertility of the inefficient should be reduced, both for the immediate benefit to themselves and for the sake of posterity; while those doing good work of all kinds should have families fully large enough to fill their places when they die The endless variety of good qualities could in this case be maintained The important contrast in reproduction is that between the unskilled labourers and skilled workers of all kinds, this is so great that the children (and adults) of the worse paid groups are drafted into the better paid occupations at the astonishing rate of about two millions in three years

THE absorption of this stream into the more cultural half of the community must be a most serious hindrance to national culture, and their continued removal leaves the less cultured half worse off than before If the situation cannot be changed or reversed, Major Darwin foresees—and it is difficult not to agree with him—that while the physical surroundings of the people might continue for some time to improve, eventually our civilisation must show signs of decay If any nation were to adopt a scheme of racial improvement, based on science and built up by common sense, and if it were to persist in this course, the improvement in moral, mental, and physical conditions would be so evident that all other countries would, Major Darwin suggests, follow such a lead

NOT content with its achievement in erecting a landmark in the history of chemical industry, Imperial Chemical Industries, Ltd, has provided the Imperial metropolis with an outward and visible expression both of its work and of the status which that work has won for the company Down by the River Thames, close to the Houses of Parliament (the division bell of which rings on the directors' floor) there has arisen in a surprisingly short time a noble building designed by Sir Frank Baines to combine beauty of form with commercial efficiency of a high order, and that degree of comfort which ministers to both, many will like to regard it as a new monument dedicated to chemists, physicists, engineers, and chemical engineers of the past, the present, and the future—a whim which will seem not altogether to lack reality when the carved portraits of Liebig, Priestley, Ludwig Mond, Alfred Mond, Harry McGowan, Lavoisier, Mendeléef, Cavendish, Dalton, and Berthelot are seen surmounting the arches of the main façades Faraday is selected for special honour, for one of the panels on the massive main door—that intended to represent the achievements of modern science—will portray a lecture by Faraday at the Royal Institution

IMPERIAL CHEMICAL HOUSE, which had to be designed while the construction progressed, contains 700 rooms, with a total floor area of 370,000 square feet, and its successful completion in less than one-third of the time which would normally have been required is no empty tribute to the efficiency of the scientific

co-ordination and control which has been applied to the task Modern methods have been freely brought into service, ultra violet rays will penetrate into the rooms; rubber flooring will contribute its special advantages; the artificial lighting will be exclusively of daylight quality The requirements of a large staff have been amply and sympathetically considered, there is carving in the spirit of Grinling Gibbons and in the technique of the Wren period, the globe desk lights bear a map of the world These three representative facts in juxtaposition surely indicate that the company intends to advance beneath a banner inscribed "What is worth doing is worth doing well"

SINCE 1877, when Werner von Siemens and Sir William Thomson (Kelvin) discussed the feasibility of harnessing the Falls of Niagara and using the power for industrial purposes, it has often been pointed out that destroying the scenic grandeur of the Falls would be a great loss to the world If the hydro electric industry were allowed to proceed unchecked, towns full of factories would spring up, the woods would disappear, and where the Falls were would be a bare cliff This has happened already in many places Luckily both the United States and Canada have been considering the problem thoroughly for the past two years, and a treaty signed by the Prime Minister of Canada and the United States Minister in Canada has been drawn up containing effective measures for the preservation of the beauty of Niagara Falls and Rapids This treaty will shortly come up for ratification The power companies in Canada and the Unites States have offered to construct remedial works at their own cost, and would accept the limitation of the maximum amount of water that can be drawn from either side of the Falls Surveys show that the escarpment is receding at an average rate of 3 7 feet per year, the maximum taking place at the notch of the Horseshoe Falls Recession of the Falls and withdrawal of water for power purposes has resulted in baring the flanks of the Canadian Falls and thinning the flow over the American Falls The remedial works would restore and enhance the scenic beauty of the spectacle, which attracts more than two million visitors annually The redistribution of the water will modify the rate of erosion at the bend of the Horseshoe It will also enable more accurate calculations to be made as to the amount of water that can be permitted to be used for industrial purposes

THE statement prepared by the Controller of the London Telephone service for the Telephone Advisory Committee, describing the progress that has been made in the London area during 1928, shows that it has been satisfactory The rate of conversion of the exchanges within the ten mile circle from manual to automatic working is perhaps disappointing, as only six automatic exchanges with a capacity of 37,150 lines were opened during the year There are now 130 exchanges in the London area, but in five years' time these will probably be 47 automatic exchanges London is connected with most of the countries in west, south, and central Europe These countries can also communicate with America through London In America the service has been extended to all parts of Canada and to Mexico The hours of service have been extended and a new radio channel has been utilised A new submarine cable of the latest design connecting England with France has been brought into service during the year, thus bringing additional circuits of high efficiency to Paris within reach of telephone subscribers in Great Britain and giving them good communication facilities with towns in the south of France The number of local calls made in 1928 was seven per cent greater than in 1927 The average number of trunk calls passing through the London Trunk Exchange was 8 per cent in excess of the preceding year Attention is directed to the damage done by the fire in the Thames Embankment subway and by the recent explosion in Holborn The former destroyed 200 main trunk and telegraph cables, and the latter damaged about twenty trunk cables In both cases partial working was resumed within a few hours and full operation within a week

IN Great Britain, Parliament has laid down a uniform charge for the transmission of telegrams irrespective of distance and of the number of retransmissions In January of last year the Hardman Lever Committee reported that the average price paid per telegram was 14 76*d*, while the costs amounted to 22 14*d* Of the costs 15 24*d* was absorbed by administration and management, operating, delivery, etc The Post Office engineers naturally hesitate to recommend the expenditure of additional capital in the circumstances As there are sufficient channels to carry the traffic, even if they are not very satisfactory ones, they have been experimenting on novel methods of increasing their carrying capacity, and at the same time of diminishing the requisite number of officials In a paper by W Cruickshank on 'voice frequency' telegraphs, read to the Institution of Electrical Engineers on Feb 14, a system was described which has been developed since the War and has proved successful in other countries In the system described by Mr Cruickshank, the currents in the line are of the same order as those used in the telephonic transmission of speech Full advantage is taken of the properties of the thermionic valve Its entire freedom from electromagnetic inertia and its extreme sensitiveness to minute changes of voltage admirably qualify it as a telephone 'repeater' The long distances between large towns on the American continent have fostered the telegraph habit Elaborate terminal and intermediate apparatus form but a small fraction of the total capital cost It pays therefore, to superpose composite telegraph circuits on telephone 'pairs' When a pair is reserved entirely for telegraphs, as many channels as possible are attached to it Successful operation of twelve channels, each carrying a start stop printing telegraph, has been achieved on many important routes The Post Office in Great Britain is experimenting on similar methods, and hopes to increase the earning capacity of its plant

THE third of the course of lectures on the early history of X rays was delivered at the Royal Institution on Feb 14 by Dr Alex Muller Two years after

Röntgen's discovery in 1895, Wiechert was able to determine the velocity of cathode rays, and by measuring their deflection in a magnetic field he succeeded in evaluating the ratio between the electric charge and the mass of the cathode ray particles In the Cavendish Laboratory, J J Thomson and his collaborators carried out a series of brilliant experiments, in which they proved the charge of ions in various gases to be a definite quantity independent of the nature of the gas Within a few years of the discovery of X rays, the existence of the electron was a well established fact Research on X rays during this period had advanced comparatively little All attempts to deflect these rays by prisms or lenses had failed The laws of diffraction did not seem to hold for X rays, and yet it seemed inconceivable that they should be corpuscular The discovery that X rays could be polarised was in favour of the wave theory, and later, direct attempts were made to estimate the wave length of X rays It was not until 1913 that it was found that X rays could be diffracted by crystals, but it showed definitely that X rays can be regarded as trains of waves, of wave length much smaller than that of visible light Then came the revelation of the connexion between the frequency of X rays and the energy of the cathode ray which made the X ray or was made by it This wonderful interchange would undoubtedly have taken years to discover if the old photoelectric effect had been the only means of approach The relation between X ray frequency and cathode ray energy involves a new universal constant, and introduces the quantum into the province of X ray theory

DR BRADFORD HILL presented a paper on sickness in various industrial occupations before the Royal Statistical Society on Feb 19 Using figures relating to printers, he showed that in short period sickness influenza is the predominant cause, supplying a quarter of all the claims between ages sixteen and fifty, and approximately one sixth of all the time lost through short periods of incapacity Next in importance are the diseases of the respiratory system In long period illness the two predominant causes are phthisis and diseases of the nervous system Illnesses of women weavers in Lancashire show that the serious excess of sickness known to exist amongst married women over that of single women is not largely due to illnesses associated with pregnancy The cost of short period illness is increasing year by year, in long period illness there is a slackening rate of increase, but the final age group, 50 69, seems to be the slowest in reaching stability A very much larger number of claims begin on the first days of the week than in the latter part of the week, while just above 50 per cent of 1400 claims ended on Saturday. This is open to two interpretations Once a week has been broken into the worker tends to consider it not worth while to return to work Alternatively, workers are loath to break into a second week's work, and therefore conclude their period of sickness at the end of a week whether they are fully recovered or not

SINCE 1918 the important scientific researches carried out at the Universities of Prague and Brno have attracted some attention, although Czechoslovak men of science have hitherto been obliged to publish the results of their investigations in journals outside their own country Consequently, many important memoirs have remained untranslated in the archives of the Czech learned societies, and it has been felt that this circumstance has not afforded the Czechs a real international reputation commensurate with their achievements A new monthly journal, entitled the *Collection of Czechoslovak Chemical Communications*, has therefore been founded under the editorship of Prof E Votoček and Prof J Heyrovský The *Collection* will contain original communications (in French or English) on pure chemistry which have not previously been published in any widely known language In addition, there will be a bibliography of all the chemical publications in Czechoslovakia, and reviews of Czech scientific books will also be given The first number has appeared and contains an article by Prof J Štěrba Böhm and S Škramovský on the complex oxalates of scandium, one by Prof J Heyrovský and S Berezický on the deposition of radium and other alkaline earth metals at the dropping mercury cathode, and two papers by Prof Votoček and his collaborators on rhamno convolvulic acid and 3 12 dioxy palmitic acid (which is derived from rhamno convolvulic acid) It may be remarked that Prof Štěrba Böhm has made a life study of the chemistry of the rare element scandium and his present communication on its double oxalates is of particular interest The authors and editors are to be congratulated upon the clarity and excellence of the language and upon the high quality of their first issue The annual subscription for the *Collection* is 170 Kč or £1

IN 1886 the late Duc d'Orleans was driven by law from France, where he had spent his childhood, and for forty years he lived an exile in England He was a traveller and sportsman, and it was pleasing to learn that no sense of bitterness against the land of his fathers prevented him from bequeathing to the National History Museum of France his unique collection of trophies That collection has now been successfully transported to Paris—no mean undertaking—and there has been arranged and thrown open to the public All familiar with the Duc and his enthusiasm for natural history, and with the steady development of his collection in the most advanced and spectacular mode of taxidermy, under the skilled guidance of Mr Burlace, of Messrs Rowland Ward, Ltd, will realise how greatly the addition must add to the popular attraction of the Paris Natural History Museum Apart from rare and valuable specimens, such as the great panda from Tibet and the mountain bush buck from East Africa, the collection includes an unrivalled series of pictorial groups ranging from the polar bears of the Arctic to many African scenes of bird and mammal life, and an Indian group of elephant and tiger The scenes, which record incidents in the travels of the Duc d'Orleans, were built under his minute direction and are a standing credit to British taxidermy A short illustrated account of the collection, by the Director of the Museum, Louis Mangin, appears in the *Revue générale des Sciences* for Jan 15

THE extraordinary extent of the repercussions of commerce upon living creatures has recently been illustrated by the appearance in Smithfield Market of a consignment of rare birds from the mountains of Central Asia They were Altai snowcock, game birds in form like overgrown black grouse, but of a predominant grey colour Little is known of the habits of the species, and few specimens existed even in the British Museum, so that opportunity was taken to replenish the collections there and at the Royal Scottish Museum An interesting article on these birds and the habits of related species written by N B Kinnear, appears in the *Natural History Magazine* for January In summer the birds live on barren hill sides above the limit of forest growth to 17,500 feet, but in winter, snow drives them down wards as low as 7000 feet As a rule they live in small coveys of six to seven, but occasionally they appear in larger flocks of thirty or so, always tame and easy to approach yet generally guarded by an outpost perched on a boulder or some other position of advantage We wonder how many of the fre quenters of Smithfield Market who ate the birds dreamed of the story behind their capture and trans port from the Altai mountains The writer can vouch for their excellence as food, though it may be that romance added savour to the dish

A REMARKABLE and instructive experiment in connexion with the education of the blind has been carried out by Mr N D Cuthbertson, librarian in the Royal Scottish Museum Following upon a series of Nature rambles arranged by him for Girl Guides he was induced to conduct a similar series for blind members of the organisation belonging to the Royal Blind School The rambles were mainly botanical, and while the march of the seasons was emphasised by concentration upon studies of foliage, flower, or fruit, attention was always focused upon significant structural characters It was a happy thought to test the result of the teaching by getting the blind ramblers to write accounts of their experiences Some of these essays have appeared in *The Teacher of the Blind*, and they show not only that the pupils thoroughly enjoyed the excursions and learned from them, but also that their tactual appreciation of fine differences in structure, such as the presence or absence of fine hairs on stems or leaves, was at least as efficient as the visual impressions of seeing pupils An excellent essay written by an excursionist who was both blind and deaf, indicates the pitch which blind deaf education has attained, and shows very clearly that a general extension of the Nature ramble movement to blind scholars and their seniors would add a new pleasure and mental stimulus to their existence

DR A E DUNSTAN delivered a lecture before the Junior Institution of Engineers on Feb 8, on recent developments in the art of oil cracking He said that cracking as applied to oil is of British and not American origin, as commonly supposed, having been first employed in 1862 in Scotland, where a plant working at 20 lb pressure was used to turn gas oil into kero sene The term cracking is American and was suggested by the noise made by oil inadvertently allowed to remain in an overheated still Last year 30 per cent of the gasolene or petrol was obtained by cracking crude oil and a further 20 30 per cent from cracked natural gasolene Although the world s consumption of oil is very great during the past seventy years only about two thirds of a cubic mile has been taken out of the earth The researches of the chemist, aided by improvements in plant, have resulted only this year in the ability completely to break down the constituents of oils and gases and the reassembly of these components in forms which at the moment may be more profitable commercially There are three essentials in oil distillation over which rigid control must be possible, namely, temperature, pressure and time An increase of 10° C in tem perature reduces by one half the time required The choking up of a pipe still system by coke residue has been eliminated by using a pulsating flow produced by an auxiliary pump

IN the *Engineer* for Feb 8 Mr Haanel, Chief of the Division of Fuels and Fuel Testing Ottawa, gives a description of the new fuel research laboratories erected for the study and investigation of Canadian fuels, solid, liquid, and gaseous Beside the chemical laboratories which contain the usual apparatus for making analyses determining calorific values and examining physical properties of fuel, the station will include a commercial by product recovery coke plant, an experimental domestic heating plant, a large scale powdered fuel steam generating plant a commercial scale briquetting plant and a large scale coal washing plant The burning of solid fuels in the pulverised form has assumed great importance in recent years one of the advantages of the system being the possi bility of utilising low grade coals which cannot be satisfactorily burned by hand firing or on any mechanical stoker Another important feature of the work of the new laboratories will be the study of low-temperature carbonisation processes as applied to Canadian coals and as occasion arises, it is proposed to test out the most promising processes, while other matters to which attention will be paid are oil cracking and refining and the production of motor oils, lubricat ing oils, waxes etc, and the distillation of oil shales such as those found in the provinces of Nova Scotia, New Brunswick, and elsewhere The new station is designed to carry out experiments in the interests of the development of the coal resources of the whole Dominion

THE Report of the Director of the Institute of Biological Research at the Johns Hopkins University indicates robust vitality and a vigorous tackling of many biological problems of first rate importance The work falls into two broad groups, general biology and human biology Amongst the former are in cluded statistical studies upon the growth of experi-mental populations, the duration of life, the factors influencing the rate of reproduction in *Drosophila*, individual growth, and the relation of organic (con-stitutional) pattern to life processes The human

investigations deal with the factors influencing longevity, senescence, and senility, the influence of alcohol upon health and longevity, the constitutional factor in disease, biometrical studies on cancer, analysis of population growth, and human genetics The programme seems greater than could reasonably be tackled, but the organisation of the Institute has now been completed according to the original plans, so that the staff of eighteen scientific workers, including the Director, Dr Raymond Pearl, has been able to settle down to the undisturbed prosecution of the plan of research In addition, however, the Director has found time to take a large part in the formation of an International Union for the Scientific Investigation of Population Problems, and to found a new journal, *Human Biology A Record of Research*, a quarterly

A publication of the National Museum of Wales has just been issued which will be of great interest and value to geologists all over the world It is by Dr F J North, the Keeper of the Department of Geology, and is entitled "Geological Maps their History and Development, with special reference to Wales" Written in scholarly fashion, and illustrated with a wealth of plates and text figures, it is, at the modest price of one shilling, at once the cheapest and best book on its subject The first part deals with the evolution of geological maps in general the birth of the idea, the development of practical methods, the law of superposition, and the period of achievement, culminating in the work of William Smith The next section is devoted to geological mapping in Wales, but so much of the pioneer work was carried out in Wales, that the history of Welsh geology is closely bound up with the history of geological progress in general The heroic period of Sedgwick and Murchison, for example, receives full and sympathetic treatment A feature particularly valuable to field workers is a classified list occupying 34 pages, giving details of all the maps that have appeared officially, in scientific journals, and in separate works during the past twelve decades Finally, there is a bibliography and index

The growth in Britain of a desire to preserve the beauty of the countryside from destruction and disfiguration and to encourage walking on the moorlands and mountains is well exemplified in the excellent little Handbook of the Ramblers' Federation of Manchester and District The book contains a record of many movements, of which some were successful, to preserve footpath rights and access to wild country There are also interesting articles on the vegetation of the Peak district, the ancient monuments of Lancashire, national parks and reserves and other subjects The growth of the Federation is a healthy sign of the appreciation of open air life and a welcome check to the ugliness of urban growth in many parts of the country

A discussion on "Ultra Microscopic Viruses infecting Animals and Plants," to be opened by Sir Charles Martin, will be held at the Royal Society on Thursday, Feb 28, at 4 30 p m

On Saturday afternoon (Mar 2) at three o'clock, Sir Ernest Rutherford delivers the first of four lectures at the Royal Institution on molecular motions in rarefied gases On Tuesday (Mar 12) Dr Stanley Kemp will commence a course of two lectures on Antarctic whaling investigations The Friday evening discourse on Mar 1 will be delivered by Sir Robert Robertson on infra red spectra, and on Mar 8 by Prof T F Tout on the place of women in later medieval civilisation

The Ministry of Health has issued a Memorandum (Memo 131 A/T) on the treatment of tuberculosis, containing an analysis of work done during the year 1927 under the schemes of local authorities Authorities concerned should find the memorandum of value in considering whether their schemes for the treatment of tuberculosis need revision in any respects in order to secure the most efficient arrangements and the best return for the money expended for the purpose

The report of the map publications and office work of the Survey of India for the year 1927–28 shows that steady progress is being made in the publication of modern maps Considerable parts of the Punjab peninsular India, the Ganges valley, Bengal, Assam, Lower Burma, and some other parts of the Indian Empire are now published on both the half inch and one inch scales The quarter inch scale is also making progress, and practically the whole of India and countries lying to the immediate west are now available on the one million scale The report contains keys to all the maps of India that are on sale

The eighth Annual Report of the Scientific and Industrial Research Council of Alberta, covering work to December 1927, has been issued from the University of Alberta, Edmonton The report indicates that the province is energetically developing its resources in a scientific manner The main part, dealing with fuels, contains data on the coals and lignites of Alberta. It was shown that good coke could be made from the coal, while the lignite could be briquetted The geological section has been extending its study of the mineral resources of the State, while the engineering section has shown that an improvement of the gravel roads could be made by the application of bitumen (preferably emulsified) obtained from the local tar sands

Two bulky volumes, Parts 1 and 2, constitute the thirteenth and fourteenth Reports of the Director of Veterinary Education and Research, Department of Agriculture, Union of South Africa (Pretoria, 1928) Some forty papers are included, dealing for the most part with diseases of animals Sir Arnold Theiler and Dr Robinson have investigated outbreaks of a somewhat mysterious disease occurring in mules and characterised by paralysis of the locomotor system. They find that it is a form of botulism due to the ingestion of the toxin of *Bacillus botulinus*, the exact 'type' of which has yet to be determined The poisoning was derived from the consumption of infected fodder The existence of equine botulism in South Africa is of interest, because about a year ago

Sir Arnold Theiler and his collaborators showed that 'lamsiekte,' an important disease of cattle, is also a form of botulism (see NATURE, June 18, 1927, p 904)

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —A second assistant chemist in the Hull Corporation Laboratories —The City Analyst, 40 Lowgate, Hull (Feb 28) A city analyst for the City of Birmingham—The Town Clerk, Town Clerk's Office, Birmingham (Mar 1) A junior assistant in the photometry division of the National Physical Laboratory—The Director, National Physical Laboratory, Teddington (Mar 2) An assistant master qualified in mathematics, at the Technical Institute, Gillingham—R L Wills, 15 New Road Avenue, Chatham (Mar 2) An assistant in the Building Department of the Northern Polytechnic, Holloway—The Clerk, Northern Polytechnic, Holloway (Mar 2) A lecturer in chemistry at the Cheltenham Technical School—The Principal, The Technical School, Cheltenham (Mar 4) A temporary chemical assistant in the Public Health Department, L C C —The Medical Officer of Health, County Hall, Westminster Bridge, S E 1 (Mar 4) A (male) junior assistant under the Directorate of Ballistics Research, Research Department, Woolwich—The Chief Superintendent, Research Department, Woolwich, S E 18 A chemist at the Test House, Kidbrooke, of the Air Ministry Aeronautical Inspection Directorate—The Secretary (I G), Air Ministry, W C 2 A male technical assistant in chemistry under the Chemical Warfare Research Department of the War Office —The Chief Superintendent, Chemical Warfare Research Department, War Office, 14 Grosvenor Gardens, S W 1 A laboratory assistant in the Naval Ordnance Inspection Laboratory, Holton Heath, Dorset—The Head Chemist, Naval Ordnance Inspection Laboratory, Holton Heath, Dorset A chief building trade instructor at the Army Vocational Training Centre, Aldershot—The Commandant, Army Vocational Training Centre, Aldershot A male technical assistant in the Chemical Warfare Research Department of the War Office, and a male laboratory assistant at the Experimental Station, Porton—The Chief Superintendent, Chemical Warfare Research Department, 14 Grosvenor Gardens, S W 1

Our Astronomical Column.

THE PROPOSED FIXED EASTER —The measure relating to this subject that was passed by Parliament last year postponed the date when it should come into operation until there was general agreement on the subject among the principal Christian bodies A step in this direction was taken on Feb 14, when the Upper House of the Convocation of Canterbury unanimously passed a resolution in favour of Easter being kept on the Sunday after the second Saturday in April It was noted by the Bishop of Truro, who proposed the resolution, that the chief difficulty would probably lie with the eastern bodies collectively known as the Greek Church Their conservatism was well known, as evidenced by the fact that they had held aloof from the Gregorian reform of the calendar for three and a half centuries, but the fact that they had now come into line with the West on this point gave hope that they might admit further change In this connexion it has been noted as a hopeful omen that practically the whole of Christendom will keep Easter on the same date this year The rule now adopted in Greece does not bring this about every year, since they follow the true moon, while the West follows the 'ecclesiastical moon,' as given by the tables of Clavius

As regards the largest Christian community, that which owns allegiance to the Pope, there have been reports during the present pontificate that the Vatican Council, which closed abruptly in 1870 owing to political events, might resume its session, in which case there is little doubt that this question of a fixed Easter would come up for discussion It is unlikely that any insuperable obstacle to the change would be found on doctrinal grounds, but there is not unanimity on the question, and it is by no means certain that a favourable decision would be reached

AN EARLY OBSERVATION OF FORBES'S COMET —Mr M Yamasaki, of the Misusawa Latitude Observatory, Japan, informs us that he detected this comet with a 7 inch reflector on a date that he gives as Oct 27 81 U.T. Unfortunately, he did not communicate the discovery to anyone until Nov 10, when he wrote to the Tokyo Observatory, had he announced it at once by telegraph, the arc over which the comet was observed would have been considerably extended He gives the position on Oct 27 81 as R A $11^h\ 1^m\ 23^s$, N. Decl $8°\ 32{\cdot}2'$ A calculation made from the latest orbit of Mr H E Wood, which includes observations from Nov 21 to Dec 20, and is certainly very near the truth, shows that the comet was very close to the position given by Mr Yamasaki on Oct 26 81 U T, but was 100′ away from it on Oct 27 81, so either Mr Yamasaki has given the wrong day for his observation or else the wrong position, the former supposition is by far the more probable, as it gives agreement both in R A and Declination

If Mr Forbes had not found the comet, it is very doubtful whether it would have been recovered from Mr Yamasaki's announcement, for by the time he wrote to Tokyo it was some twenty degrees distant from its position when he saw it, and no clue was given as to the direction or rate of its motion Promptness in the announcement of cometary discoveries is highly desirable

THE PARALLAX OF ALPHA CENTAURI —The parallax of this interesting star, so long regarded as our nearest stellar neighbour, has been investigated photographically by Dr H L Alden, at the Johannesburg Station of Yale University Observatory The results are given in the *Astr Jour*, No 913 It is the first time that this parallax has been determined by modern photographic methods, and it is satisfactory to find that the result is in perfect agreement with that of Gill and Elkin from the Cape heliometer that was $0{\cdot}758'' \pm 0{\cdot}010''$, while Alden's is $0{\cdot}757'' \pm 0{\cdot}006''$ The parallax of Proxima Centauri, the distant companion that Dr Innes found at a distance of 2° 11′ from the bright star, was also measured and found to be $0{\cdot}785'' \pm 0{\cdot}005''$ The weighted mean of the previous results of Voûte and Innes was $0{\cdot}765'' \pm 0{\cdot}021''$ Alden adopts the combined result $0{\cdot}783'' \pm 0{\cdot}005''$ This star is therefore nearer to us than Alpha Centauri by one seventh of a light year Its photographic absolute magnitude is 18 5, the visual being 16 5, its linear distance from Alpha is about 14,000 astronomical units

The paper also contains a discussion of the relative masses of the two components of Alpha. The brighter star is found to have a mass 1 06 times the sun's, and the fainter 0·92 times. It is pointed out that the period 1945–1952 will be specially favourable for determining the relative masses, as the curvature of their relative motion will then be great.

Research Items

Gebel Haraza.—In *Sudan Notes and Records*, vol. 10, Mr. H. A. MacMichael contributes some notes on the inhabitants and antiquities of the range of hills in the Sudan known by this name. The nomenclature of the peaks—each has its own name—is generally non-Arabic, and the proportion roughly represents the relative proportion of Arabic and non-Arabic blood. The present inhabitants are a mixture of Rekâbia and some other race. The Rekâbia migrated from Mundera on the Nile in the eighteenth century and expelled most of the previous inhabitants, intermarrying with the women who remained. They are particularly able and acute. The other inhabitants call them Nuba or Shaberga and they sometimes admit relationship with the Nuba of Kordofan. They say their fathers found a still earlier and alien civilisation at El Haraza, and as a matter of fact the earlier inhabitants were far more advanced in civilisation, working in stone, making, for example, rings of stone (granite, flint and sandstone) and hollow conical ornaments of unknown purpose, now used as amulets. Ironworks are still to be seen with back walls ranging in tiers, all with a number of concavities, presumably each intended for a single worker. Cylinders of hard burnt clay for use with the bellows lie about in large numbers. These earlier tribes produced rock pictures which are to be seen in three spots; some are in a red pigment and some in a white. At Kurkeila they are chipped roughly and indistinctly on the rock surface. The appearance of the camel suggests they may be fairly modern. The pictures at Shalashi are on the roof of a cave formed by a fallen boulder. They are beautifully proportioned and represent men on horseback, the horses being of the type of the Egyptian paintings, while the men have broad chests and narrow hips like the Egyptian figures.

Solutrean Sculpture.—M. Henri Martin, who for many years has been engaged in excavating sites in the valley of the Roc (Charente), brought to light in 1927 a remarkable series of five sculptures, perhaps the finest ever discovered together, in a rock shelter situated on the slope of a cliff on the right bank of the river. These have now been deposited in the St. Germains Museum, and, with other features of the site, are described and very fully illustrated in Mem. 5 of the *Archives de l'Institut de Paléontologie humaine* of Paris. The area constituting the site contained two cave stations and two shelters, but the talus yielded a considerable amount of material. In one of the shelters three skeletons of Chancelade type were discovered. The other had evidently been used as a workshop. More than two thousand implements, flakes, ornaments, etc., were recovered from it. Traces of a hearth were also found. At the back of the shelter were large blocks of rock which had fallen either before or early in the occupation of the shelter, and on these were the five sculptures forming a frieze. They are executed in high relief and depict Bovidæ or pseudo-Bovidæ, horses, and men. Certain remarkable features are to be noted. In the first place, as regards situation, these sculptures are in full sunlight and not in the darkness of a cave like Magdalenian art. Secondly, while the human figures are poorly and conventionally represented, the animals are represented with the greatest fidelity. This is to be seen especially in the accurate swell of the joints and the play of muscle. The cloven hoof of the bull is always shown. Thirdly, the horses are pregnant. While, therefore, the situation differentiates these drawings from the Magdalenian, to which a magical purpose is attributed, their fidelity and truth suggest a delight in creation for its own sake. Yet the pregnancy of the horses, as well as one human figure, possibly masked and dancing, suggest a religious motive in relation to fertility.

Tuberculosis in Wild Animals.—The existence of tuberculosis in wild animals living under natural conditions is practically unknown; a few instances have been recorded in ground squirrels in California. Messrs. R. Paine and G. Martinaglia, of the South African Veterinary Service, now report cases among wild buck in the Albany District of Cape Province (*Journ. S.A. Veter. Med. Assoc.*, vol. 1, No. 2, 1928, p. 87). Five cases were met with in the kudu antelope (*Strepsiceros strepsiceros*) and one in a duiker ewe (*Sylvicapra grimmi*). Five out of the six cases were fully investigated and yielded the bovine strain of the tubercle bacillus.

Life Cycle of *Echinobothrium*.—J. S. Ruszkowski (*Bull. Int. Acad. Polonaise Sc. Lettres*, 7 B, 1928) describes a new species of *Echinobothrium* (*E. benedeni*) from the intestine of two species of skate (*Raia asterias* and *punctata*) taken at Roscoff. By examining the undigested food in the stomach of the skate as soon as possible after capture, he found three samples of the prawn *Hippolyte varians*, in which altogether were four larvæ of *Echinobothrium*. The larvæ of *E. benedeni* and probably those of other species have numerous well developed crotchets on the head, but none on the cephalic peduncle. There is probably only one intermediate host in the life cycle of the Echinobothriidæ in general and of *E. benedeni* in particular, an important difference from the Bothriocephalidæ, in which two intermediate hosts are necessary.

Salmon of the River Conon.—Mr. W. J. M. Menzies, Assistant Inspector of Salmon Fisheries for Scotland, describes the results of his examination of the salmon of the River Conon in 1927 (Fishery Board for Scotland, Salmon Fisheries, 1928, No. 8). This river, with its attendant lochs, is a difficult one for salmon, as most of these lochs are barred by impassable falls and the tributary streams are in consequence inaccessible. Ascending salmon have a hard life and a rough passage, the scarcity of food in the upper waters due to high ground, lack of lochs, and rough, rocky bottom making life none too easy for the parr. The result is that these parr grow slowly, and consequently a high average age of migrating smolts is shown. The author has examined more than 1100 sets of scales, forming a good representative proportion of the catches. In 1927 the largest fish caught in the nets weighed 35½ lb., whilst one barely half a pound heavier was caught in 1928. The largest caught by a rod in recent years weighed 30½ lb. and was 41.25 inches long. The salmon in the Conon are predominantly of the younger age groups and return after spending a minimum of time in the sea. The catch of the early season is composed almost entirely of small spring fish which have spent nearly two complete years in the sea. In May these are intermingled with small summer fish in about the proportion of two to one, in June small summer fish with grilse in the proportion of about two to one, and in July and to the end of the season grilse predominate. Out of 67 fish that had previously spawned, only 3 had spawned more than once, two came up as grilse and then spawned in two successive years, and one, after appearing for the first time as a small

spring fish, spawned twice, but spent a complete year in the sea between each visit to fresh water This fish must have been nine years old when captured, and weighed 20 5 lb The average age for smolts in the Conon is very high, 42 per cent being two years, 53 per cent three years, 4 per cent four years and a few five years of age at migration Their calculated lengths are low They had a specially vigorous growth in the sea The average size of the grilse and summer fish is large and the grilse are exceptionally fat

MORPHOLOGY OF THE SKULL OF GNATHOSTOMATOUS FISHES —Mr E Phelps Allis (*Jour Anat*, vol 63, pt 1, 1928) gives a detailed review of the present position regarding the morphology of the skull in gnathostome fishes, with special reference to the origin and homologies of the pituitary fossa, the myodome and the trigemino facialis chamber He first of all gives a connected and detailed statement of his own theory, based on his work on *Ceratodus* This is followed by a chronological review of the more important work on the subject from Gegenbaur in 1872 to de Beer in 1927 The author then discusses the evidence derived from this work and its bearing on his own theory, particularly in the light of the criticisms of de Beer He concludes by re affirming in all its essentials his interpretation of the morphology of the gnathostome fish skull first published in 1914 His paper is a valuable and critical statement of the present position of the matter and a notable contribution to vertebrate morphology

STUDIES OF CHLOROSIS IN FRUIT TREES —Mr T Wallace presents the results of further studies of this subject (see NATURE, Oct 13, 1928, p 587) in the *Journal of Pomology and Horticultural Science*, 7, pp 172 183 and 184 198, December 1928 In the case of lime-induced chlorosis, he shows again, by a chemical examination of leaves, wood, and bark of the current season's shoots, that whilst in the chlorotic leaves, in this case of pear, plum, and raspberry, the ash content on dry matter is high, the relative proportions of potassium and calcium are different from those obtaining in the green leaves, potassium increasing and calcium falling in the chlorotic leaf These characteristics of ash distribution hold also for the bark, but not for the wood of the chlorotic shoots On the other hand, in the case of a chlorosis of plums, due to deficiency of potassium, this element was poorly represented in the ash of the leaves of the chlorotic plants, which also had a low ash content on dry weight In the case of this type of chlorosis, which occurred on soils where leaf scorch trouble might also be anticipated, spraying with ferrous sulphate was ineffective as a control, whilst potash manuring was a successful remedial measure

ROOT INFECTION OF TEA PLANTS —As a result of a visit to Nyasaland in February and March 1927, Dr E J Butler has written a "Report on some Diseases of Tea and Tobacco in Nyasaland (issued by the Department of Agriculture, Nyasaland, Zomba, July 1928), which gives a general account of the diseases of these crops met with on his tour, which should be of considerable interest to all growers of tea and tobacco An interesting feature in the report on tea diseases is the proportionately large space that has to be devoted to infectious diseases that appear to spread via the root systems *Armillaria mellea* is of course one of the most striking of these parasites, and a very clear account is given of the appearance of trees which have fallen victims to this pest. But stumps also appear to be rotted by *Ustulina zonata*, which has elsewhere proved a parasite to rubber (*Hevea*), whilst an internal root-rot *Botryodiplodia theobromæ*, when present, seems to be an even more deadly foe than either of these other parasites in the light of the planters' observations Dr Butler discusses the symptoms and manner of spread of an obscure root disease, often attributed to this last fungus, but concludes that the identity of the pathogen in this case must remain an open question for the present Root diseases are probably all the more prevalent from two cultural practices When ground is cleared, removal of the plant cover causes rapid washing out and impoverishment of the soil As a result, root growth is poor and the root system more susceptible Then, on the other hand, tree stumps are not cleared out after felling, and, from his wide experience, Dr Butler describes in an interesting manner the prevalence of centres of root infection which radiate from rotting stumps, and from stumps of some species of trees more frequently than others

FOSSIL FRESHWATER MUSSELS FROM PERU —W B Marshall describes (*Proc U S Nat Mus*, vol 74, art 3) some fossil pearly freshwater mussels from deposits at the head waters of the Upper Amazon, Peru The exact geological horizon from which they were obtained has not been definitely settled, but Conrad considered that they could scarcely be later than Tertiary Brackish water forms are associated with these mussels, which must have been swept down from higher levels by floods Five new species are defined, for which the author creates two new genera *Prodiplodon* and *Eodiplodon*

COLORATION OF MOLLUSCAN SHELLS —E W Bennett records some observations on New Zealand Mollusca in *Records of the Canterbury Museum* (vol iii p 185, November 1928), and concludes that in most shelled mollusca the degree of pigmentation is in proportion to the degree of exposure to light in the natural habitat of the species in question He regards the pigment as a protection, probably against ultra-violet rays Although pigment, "unfortunately," as Mr Bennett says, usually has disappeared from fossils, still its occasional recorded presence may throw some light on the habitat of the extinct species

ANALCITE ROCKS OF AYRSHIRE —Dr G W Tyrrell has published an important contribution to the petrology of analcite-bearing rocks (*Quart Jour Geol Soc*, pp 540-567, 1928) The rocks of the Ayrshire province are generally thoroughly basic, ranging from crinanite and teschenite through picrite to peridotite It is therefore particularly interesting to find more felsic rocks—analcite syenites—occurring in differentiated sills of crinanite as bands, schlieren, and veins The occurrences described, of which that at Howford Bridge, Mauchline, is the most important, are all of late Carboniferous or Permian age Variation within the sills is ascribed to crystallisation differentiation aided by the settling of heavy titanaugite-ilmenite intergrowths Several continuous and discontinuous reaction series have been traced, and it is clearly shown that a certain amount of lime must thereby have been restored to the residual magmatic liquor, along with the usual alkalis, silica and volatiles, leading to the final crystallisation of analcite, soda-lime zeolites, and prehnite It is noted that the great development of analcite syenite within the Howford Bridge sill is concomitant with the impoverishment of the associated crinanite in analcite In the other sills, the crinanites are richer in analcite, and analcite-syenite is correspondingly sparse

TAJIMA (JAPAN) EARTHQUAKE OF 1925 —This destructive earthquake occurred at 11 h. 10 m 49 s.

(2 h 10 m 49 s, G.M.T.) on May 23, 1925, in the boundary district of the provinces of Tajima and Tango. It was followed, on Mar. 7, 1927, by the much stronger Tango earthquake with its epicentre only 11 miles farther east (NATURE, vol. 122, p. 36). The Tajima earthquake is the subject of valuable memoirs by Prof. B. Koto (*Tokyo Imp. Univ., Fac. of Sci. Journ.*, vol. 2, 1926, pp. 1-75), by Prof. A. Imamura (*Imp. Earthq. Inv. Com. Bull.*, vol. 10, 1928, pp. 71-107), and by Prof. N. Yamasaki (*Ibid.*, pp. 109-113). The epicentre lies to the east of Tuiyama Cove and close to the village of Tai. The focus must have been of considerable size in the vertical direction. From a study of the intensity distribution, Imamura concludes that its depth was about 6 miles, while Dr. K. Wadati, from the transmission curves of the $\bar{P}$ and P phases, estimates it at 20 miles. On the top of a hill near Tai, two faults were formed, each about a mile long, running north-east and south-west, roughly parallel to one another and to the old steep fault-scarps facing Tuiyama Cove. The greatest vertical throw was about 3 ft. 3 in., and the horizontal shift (of the west side towards the north) between 2 and 3 inches. The Tajima and Tango earthquakes occurred on the north side of the island, in what is known as the inner seismic zone, and within four years after the great Kwanto earthquake of 1923. Prof. Imamura notices that several other great movements in the east or outer seismic zone (in 1676, 1854, 1894, and 1896) were followed within a few months by others in the inner zone.

AN UPPER LIMIT TO ENERGY DENSITY.—In the September issue of the *Proceedings of the Physico-Mathematical Society of Japan*, Prof. S. Suzuki puts forward the hypothesis that there is a limit to the energy which can be concentrated in a given volume, just as on the theory of relativity there is a limit to the velocity a body can have. It would follow from such a hypothesis that as the energy density in an enclosure is proportional to the fourth power of the absolute temperature of the enclosure, there is an upper limit to temperature. Planck's radiation formula would require an additional term which becomes important for long waves and high temperatures. The frequency of a light quantum could not increase indefinitely, and the Compton increased frequency effect could not be produced when an extremely rapid electron struck a quantum of extremely high frequency.

ELECTRIC STARTERS FOR MOTOR CARS.—Owners of motor-cars are chary of using their self starters too often as they fear that the battery may lose too much of its charge. They will be interested, therefore, in a paper by Dr. Smith Rose and Mr. Spilsbury on tests of electric starters for motor cars, which is published in the *Journal of the Institution of Electrical Engineers* for January. The instantaneous values of the currents during starting were found by an oscillograph. The first car experimented on had a nominal 12 horse-power, 4 cylinder engine with a 12 volt battery. It was started by means of a dynamotor unit permanently connected to the engine shaft by a chain drive. The tests were made with the engines both hot and cold. Each of the other two cars had a separate starter motor unit, the driving pinion of which was only engaged with the engine fly wheel during the actual starting operation. In car No. 1, when the starter switch was first closed the current jumped up to a value of 195 amperes, the battery pressure rapidly falling from 12.4 to 9.3 volts, and then rising. In car No. 2, the current rushed up first to a peak value of 154 amperes and then to a second peak value of 228 amperes. With the third car they found a peak current of 260 amperes at the instant when the pinion and flywheel engaged. These large currents are of importance in practice, as they doubtless damage the battery by displacing paste from the plates. It seems likely that their value determines the life of the battery. It is satisfactory to find, however, that although the currents are so large the total quantity of electricity discharged from the battery during a normal starting operation is very small. The tests show that the engines started up from their cold condition in times varying from 0.39 to 0.75 of a second after pressing the switch. This corresponds to a total discharge varying from 63 to 128 coulombs. With the engines warm, they started in about half the time and used half the coulombs. It is concluded, therefore, that with a normal car there is little risk of the battery becoming discharged owing to frequent use of the starter.

CARBON SULPHIDOSELENIDE.—A new method of preparation of carbon sulphidoselenide, CSSe, together with an account of its properties, is described by H. V. A. Briscoe, J. B. Peel, and P. L. Robinson in the *Journal of the Chemical Society* for January. This compound was previously prepared by Stock and Willfroth by striking an arc between carbon poles containing selenium, under carbon disulphide, but the new method consists in passing carbon disulphide vapour over heated ferrous selenide, when a partial replacement of sulphur by selenium occurs. Carbon sulphidoselenide is a deep yellow liquid boiling at nearly 84° and having a density of 1.9874 at 20°. Its constitution, as deduced from surface tension measurements, appears to be Se = C = S, but it is less stable than carbon disulphide. Carbon sulphidoselenide has an unpleasant odour and is non-inflammable; its vapour is lachrymatory. It is immiscible with water, but soluble in most organic solvents. With phyenlhydrazine and aniline, carbon sulphidoselenide reacts in a manner analogous to carbon disulphide.

PHYSICO-CHEMICAL INVESTIGATIONS UPON RADIUM.—The increased demand for radium preparations for use in the cure of certain diseases has caused attention to be directed to the supplies available from the Belgian Congo. It has apparently been overlooked that the element was first discovered by Prof. and Mme. Curie in the pitchblende deposits of Jáchymov (St. Joachimsthal) in north-west Bohemia, where the isolation of radium products has been resumed since 1920. In the *Collection of Czechoslovak Chemical Communications* (January 1929), Prof. J. Heyrovský and S. Berezický describe the application of the dropping mercury cathode methods for determining the deposition potential of radium, which is found to be 1.718 volts. The deposition potential of the element in the presence of barium and other salts was also studied, using preparations containing amounts ranging from 14.6 per cent of radium to a preparation containing 97.3 per cent of radium chloride. It is found that the difference in the deposition potentials of the alkaline earth metals are great enough to permit of the deposition of each of them being followed in their mixtures. Traces of radium are noticeable in any amounts of calcium or strontium solutions, even in the presence of alkali metals. The deposition of radium becomes indistinguishable, however, when the ratio of barium to radium exceeds 10 : 1. Traces of barium are discernible in solutions of all the alkalis and alkaline earths. The application of the polarographic method with the dropping mercury cathode to the determination of the solubilities of sparingly soluble salts has also been found to give concordant and satisfactory results.

The British Industries Fair.

THE London section of the British Industries Fair, organised by the Department of Overseas Trade, was opened at the White City on Feb 18, the Birmingham section, which was organised by the Chamber of Commerce under the auspices and with the support of the Department of Overseas Trade, being simultaneously opened at Castle Bromwich Both sections will be open from Feb 18 until Mar 1 inclusive Only British manufacturing firms were permitted to exhibit, and no exhibitor might exhibit articles other than those of his own manufacture

The primary appeal of the Fair is to trade buyers, and in order to attract them a special advance over seas edition of the catalogue of the London section was issued early in January to 10,000 business men in Europe, North America, South Africa, and the eastern coast of South America, in time to enable buyers in cities so far apart as Constantinople, Cape Town, and Vancouver to receive a copy before commencing their voyage to England The catalogue contains descriptions, though in little more than bare enumeration, of the exhibits of more than 1200 British manufactures, and embodies a complete classification of all those exhibits by trades, as well as indexes in nine languages, thus enabling foreign buyers easily to trace the goods in which they are particularly interested As catalogues go, it is as clear as its conciseness will allow, but the authorities responsible for its publication might realise that its format, by the mere growth of its pages, is now become awkward There are 400 pages constituting the body of the catalogue, with more than 260 pages of advertisements in addition The size of the page being relatively small, the result is a paper backed volume an inch thick which has to be so tightly pasted that it is difficult to open the catalogue widely enough to enable the beginning of the line to be read with ease

No less than 39 trades (several of them being really groups of trades) are represented in the London section, from perambulators to pianofortes, but readers of NATURE will naturally be more interested in the scientific industries An outstanding exhibit is that of the Imperial Chemical Industries, Ltd, that 'rationalised'—to use a term currently fashionable—embodiment of more than forty subsidiary and associated companies, operating throughout the British Empire and the world This exhibit comprises heavy chemicals, explosives and ammunition, dyestuffs, metals and fertilisers, all of which are shown on a large site having for its central feature a cinema hall Here films are shown continuously illustrating the manufacture of heavy chemicals, the making of dyestuffs, the use of blasting explosives (depicting the fall of 30,000 tons of limestone), and a film showing by examples the uses of fertilisers and their benefit to agriculture

British optical and scientific instruments and photographic goods occupy nearly 8000 square feet This section was inaugurated only in 1926, when there were 22 exhibitors, occupying 1700 square feet This year there are 60 exhibitors occupying no less than 7662 square feet—a significant testimony to the rapid growth of these important branches of British industry In view of the growing use of optical and scientific instruments for purposes of research, control, and test, in an ever widening and varied field of industrial processes, the exhibits in this section should grow more rapidly still if the manufacturers concerned realise the value of the opportunities that the Fair provides. A glance through the optical section shows that many of the leading British optical manufacturers, some of whom have deservedly a world wide reputation, are represented, though there are also some not less notable omissions It may be that for optical instrument manufacturers and also for the manufacturers of scientific instruments, in the stricter sense, the annual exhibition of the Physical and Optical Societies, held usually in January at the Imperial College of Science, South Kensington, provides a better *milieu* for appeal to the experts who can best judge of the value of such productions

This view may account, in part, at least, for the list of exhibitors in the optical and scientific instrument section of the British Industries Fair being less comprehensively representative than it might be One can readily understand that the expenditure of time, energy, and money needed for the preparation of exhibits may easily constitute a serious financial burden on any firm, and more particularly on the comparatively small industrial units engaged in the optical and scientific instrument industries, if there should be an undesirable increase in exhibitions But the British Industries Fair, with its wide range of appeal to trade buyers from the four corners of the earth, should provide a very suitable opportunity for display complementary to that provided by the annual exhibition of the Physical and Optical Societies

The pre eminence of British optical and scientific instruments in certain lines is unquestioned, but there are certain types of optical and instrument products in which the legend still lingers that particular foreign products are the best, even though recent improvements in the corresponding British productions may have falsified the legend The British Scientific Instrument Research Association, for example, has recently published the results of a prolonged investigation into the characteristics of some typical British and foreign ammeters and voltmeters of the switchboard pattern One upshot of that investigation is the definite conclusion that "the best known British instruments of the kind dealt with are quite equal to the best known corresponding products of foreign origin, in the suitability of their design for the purpose to be served, in the consistency of their indications, and in the general lines and details of their construction"

Among the conspicuous features of the exhibits of British optical and scientific instruments and photographic goods, the following may be mentioned Ultra violet ray equipment, embodying automatic control of the time of exposure, daylight lamps which, it is claimed, give the same effective results as before with the use of considerably less current, compasses suitable for fast motor boats and a depth-sounding device for use at full speed, inter communication telephones for use on aeroplanes or ships where noise makes the use of ordinary instruments impossible, a new splinter proof glass for spectacles, the colour 'snap shot'—the special film which makes it possible to take colour 'snap shots' with an ordinary camera, a roll film reflex camera for speeds up to 1/5000th of a second, and a photographic plate with a speed of '2000 *H* and *D*,' to use the appropriate technical term—four times as rapid, it is said, as any plate previously produced

Scientific exhibitors, actual or potential, should also realise that, apart from the direct benefits in the shape of trade orders that are likely to accrue from the exhibition, the display of a representative and fairly comprehensive collection of optical and scientific instrument exhibits in a Fair organised by a department of Government may also have its indirect benefit in assisting Government to realise the value and importance, from a national viewpoint, of these particular industries

The Paulin Aneroid

THE Swedish engineer, G Paulin, has recently applied the null reading principle to the aneroid barometer The action of the instrument will readily be understood from the illustration (Fig 1) The diaphragm *a*, the total range of motion of which is restricted by means of stops to about $\frac{1}{10}$ mm, actuates the frame *j*, to the upper ends of which are attached phosphor bronze strips, bent at an angle and fastened at their lower ends to the base To the angles of the

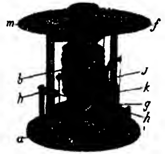

Fig 1.

latter strips are attached two horizontal strips *k*, which are pinned above and below a transverse torsion strip *g*, held by springs *h*, and carrying the *null* pointer *f* It will be seen that a rise or fall of the diaphragm alters the angles of the bent strips and imparts a twist to the torsion strip *g* through the horizontal strips *k*

The *scale* pointer *m* is carried by a central threaded spindle, passing through a nut attached to the upper end of the spiral spring *b* The lower end of this spring is coupled to the diaphragm Varying air pressure on the diaphragm is thus equilibrated, and the diaphragm thereby restored to its null position by the measured rotation of the central spindle

The writer has recently had an opportunity of testing this type of barometer on an experimental survey in the Eastern Highlands of Scotland, in the course of which checks on the aneroid readings were obtained at frequent intervals by means of trigonometrically fixed heights. Normal surveying practice was followed by reading a stationary barometer at intervals during the field traverses to allow for diurnal and weather changes of pressure, and the effect of varying temperature of the air column was allowed for, on the usual isothermal assumption, in reducing the field readings

The makers claim that friction errors are eliminated, and this claim would appear to be substantiated The reading is always consistently definite and is not affected by tapping

The extent of the first climb in the early morning was invariably *exaggerated* by the instrument to the order of 1½ per cent This error is not due to hysteresis, since it is in the wrong sense Neither is it due to want of sympathy between the makers' graduation formula and the local meteorological and geographical conditions, for an independent computation from the International formula reveals no greater difference on this score than 0 1 per cent The only alternative which suggests itself is faulty temperature compensation of the particular instruments under trial Temperature fell considerably during the climb, and it is likely that insufficient time was allowed before starting to enable the traverse barometer to take up the outdoor temperature It is indeed difficult to see how the mechanism described in the makers' catalogue can be compensated On the other hand, the writer has been shown the results of National Physical Laboratory tests on other barometers of this type, which indicate remarkably good temperature compensation Possibly the difficulty has been overcome in later models, at any rate in selected specimens

Minor variations in altitude were recorded to within one or two feet of truth, and in all cases where the temperature remained sensibly constant the traverse closed to within two or three feet, even after a sudden drop of a thousand feet

This instrument would appear to mark a step forward in the design of surveying barometers, although more extended field trials are necessary before this can be stated with assurance M H

Isostasy

By George R Putnam, U S Department of Commerce, Washington, D C

THE condition of equilibrium in the crust of the earth is maintained by under-surface compensation of some sort, between the extremes of no compensation (a rigid crust) and complete local compensation (a plastic crust) Common knowledge shows that the materials of the crust are too weak for rigid support of the relief, and are too strong for complete local isostasy What, then, is the most probable arrangement of the actual isostatic compensation ?

Gravity measurements furnish the principal evidence Of the methods for their discussion, the reductions of Bouguer and Hayford correspond to the above two extremes The large Bouguer anomalies prove that the crust is not rigid In papers printed in the May 1928 issue of the *Proceedings of the National Academy of Sciences*, I have shown that the Hayford hypothesis of complete local compensation is untenable, and leads to significant error

The Hayford method assumes that the isostatic compensation is "complete under every separate portion of the earth's surface," however small This hypothesis was not claimed to be completely true, but this notable work has been built around local compensation, as complete as mathematically practicable Hayford and Bowie allude to any error due to this assumption as a negligible matter The Hayford reduction divides the area about the station into very small compartments, and assumes complete local compensation for each The first zone is a cylindrical column 2 metres in radius and extending downward 113,700 metres (71 miles), and this column is assumed to be in perfect equilibrium, free to move without resistance from surrounding materials This cannot represent a condition possible in Nature Such compensation could be true only with materials wholly plastic, and no remaining surface relief

The errors in the Hayford residuals show as overcompensation for stations above the average level, and as under-compensation for stations below, they are appreciable or large for mountainous stations, but negligible in fairly level regions They are similar to the 'free air' reduction errors, although much smaller The proofs given depend mainly on comparisons of pairs of adjacent gravity stations differing materially in elevation. The evidence shows that regional compensation cannot be ignored in gravity reductions

I also used this strong method by pairs, for a measure of the horizontal extent of regional compensation, and find evidence that this is appreciable to about 160 kilometres (100 miles) from the station

Another basic hypothesis of the Hayford reduction is that the densities so vary with the elevation that the mass in a unit column is constant This cannot be true even approximately, in mountainous regions, for small unit areas The correct conception is that of limited regional compensation horizontally, which is the same as incomplete compensation vertically, or partial lack of local compensation, for features of moderate extent

All this affects the discussion of the so-called Airy and Pratt theories With regional isostasy there will be horizontally extended compensation beneath mountains, instead of individual downward protuberances Probably the depth of compensation varies appreciably, and the topographic relief must be explained by more than one kind and direction of force

To bring the gravity measurements within the possibility of mathematical treatment general assumptions cannot be avoided, but these must be physically reasonable, and be such as to result in minimum residuals

In the papers to which reference has been made, two regional isostatic methods of reduction of gravity observations are given One, a more accurate method now first proposed, uses a practicable regional system of reduction by averaging the elevation for moderate areas about the station, thus avoiding the local compensation error It yields results nearer the truth than the Hayford method, and requires less labour A more correct, but less readily computable, conception, would substitute a warped surface for a levelled area about the station

The second method, the 'average elevation isostatic reduction,' was devised and used by me in 1895, it averages the surface elevation within 100 miles of the station, and applies a compensation for this average elevation This is a simple method, although approximate, as it neglects curvature On a reasonable conception of isostasy, it eliminates or greatly reduces the extreme residuals in mountainous regions This method is of special significance in the general problem, as it proves isostasy without using the Hayford assumptions It is not based on any assumption as to the thickness or vertical density arrangement of the compensation, providing it is at a considerable depth, and hence an unlimited number of combinations of these elements will satisfy the condition of isostasy This reduction is a regional treatment of compensation, and the area used conforms well to that found, by more exact methods, to be regionally compensated It confirms the previous conclusion that regional isostasy cannot be ignored

In 1894, gravity measurements across North America were made by me for the Coast and Geodetic Survey, at stations which had been carefully selected to test the condition of the earth's crust I applied this average elevation reduction to these and other determinations, representing extreme and diversified conditions This work, on a basis of isostasy, eliminated the larger residuals which all preceding methods had failed to do, and it was the first consistent proof of isostasy

The first observational evidence of crustal equilibrium came from British trigonometric and gravimetric surveys in India The first definite proposal of this theory was made by Airy seventy-three years ago, and English scientists have continued to make valuable contributions to the theory of isostasy

University and Educational Intelligence

Cambridge —The governing body of Emmanuel College offers to a research student commencing residence at the University in October next, a studentship of the annual value of £150, tenable for two years Preference will be given to a candidate who has already completed at least one but not more than two years of research Applications should reach the Master of Emmanuel (The Master's Lodge, Emmanuel College, Cambridge, England) not later than June 30

The Geological Department of the University of Melbourne has been provided with a new building at the cost of £21,000, by a grant from the Government of Victoria On the occasion of the opening of the new building by Lord Somers, the Governor of Victoria, a pamphlet has been issued summarising the history of the Department and giving a list of positions obtained by its graduates, and of the 123 papers issued in connexion with the School during the past twenty three years The pamphlet refers to the early history of the school under its founder, Sir Frederick McCoy, from 1854 until 1899, Prof Gregory during the next five years, and Prof Skeats since 1904 It has been conducted in recent years in a joint building with metallurgy erected in 1905 The growth in the number of students has rendered necessary the provision of the present large and well equipped building The staff of the Department includes Dr Summers as associate professor and Mr Frederick Chapman, of the Victorian National Museum and now acting as Palæontologist to the Australian Federal Government, as lecturer in palæontology

Studley College, Warwickshire, is appealing to the public, and especially to those having agricultural interests, for £20,000 to enable it to continue its work of providing courses of instruction for women in horticulture, agriculture, dairying, and poultry-husbandry Originating as a hostel at Reading in 1898, the College moved in 1903 to Warwickshire, where it became a teaching centre for gardening and dairying It now provides a three years' diploma course in horticulture, two years' courses in horticulture, in agriculture, in dairying, and in poultry husbandry, one year and shorter courses in the above subjects and instruction in carpentry, bee keeping, fruit bottling, and floral decoration The fees for tuition and residence amount to 110 guineas and upwards per annum The College is always full, and the demand made upon it for trained workers is greater than it can supply with its present accommodation, which is limited to sixty resident students Of the twelve hundred women who have passed out from it, many are now managing their own land or earning salaries not only in Great Britain but also in Australia, New Zealand, Uganda, Kenya, South Africa, Canada, India, and Ceylon, where they are growing crops of all kinds, including cotton, lemons, oranges, coffee, and tobacco In 1911 the College obtained a lease of Studley Castle estate, comprising the castle, farm buildings (now needing repair and enlargement), and 340 acres of land This lease is now drawing to a close and £15,000 must be raised before July 1 to complete the purchase of the freehold Towards this the Treasury has promised a grant of £5000, former students have pledged themselves to find £1000, and the present students and staff are contributing £300 The College is recognised by the Ministry of Agriculture and Fisheries, from which it receives an annual grant of £1000 The appeal is signed by the Marchioness of Londonderry as president Donations may be sent to the honorary treasurer, Mr H Keeling, 26 Eccleston Street, London, S W 1

Calendar of Patent Records.

February 26, 1781—The pigment known as 'Turner's Yellow' or 'Patent Yellow' was the subject of a patent granted to James Turner on Feb 26, 1781, and was at one time extensively used The validity of the patent was twice upheld in the courts and its life was extended by Act of Parliament (32 Geo 3, c 73) on the ground that "the colour was made from British materials, and that the invention has not only in a great measure superseded the necessity of importing the colour from abroad, but it is now exported in considerable quantities to most parts of Europe, the East and West Indies, and America, and by the great consumption of common salt necessarily used in preparing the same the said invention will afford an increase to the public revenue" Like most lead paints, however, 'Turner's Yellow' is affected by long exposure to a sulphurous atmosphere, and the introduction of the chrome colours has rendered it obsolete

February 27, 1802—The closed kitchen cooking range was first patented by George Bodley, of Quay Foundry, Exeter, on Feb 27, 1802 The patent was for a stove constructed with an oven on one side and a boiler on the other, the flue gases passing from the upper part of the stove round three sides of the oven, under and up one side of the boiler, and then into the chimney, the whole being covered with a plate upon which vessels could be warmed

February 28, 1799—The so called American type of windmill, in which instead of the small number of sails of large size, common to the mills of Europe, there is a large number of small blades arranged in wheel formation, was included in an English patent granted to George Medhurst on Feb 28, 1799

February 29, 1612—The patent granted to Simon Sturtevant on Feb 29, 1612, for the use of coal in all metallurgical operations, including iron production, was surrendered the following year, and it is chiefly of interest now because in it Sturtevant foreshadowed with remarkable accuracy the procedure, adopted officially much later, of filing provisional and complete specifications in connexion with patent applications Sturtevant not only annexed to his petition for a patent a statement describing "in some measure" his invention and the method of carrying it out, but he declared also that the invention would be "more fully, amply, and particularly demonstrated, specified, described, and contained, in a large treatise which shall be put in print and published before the last day of Easter term next," and the treatise was in fact published by the date mentioned The specification did not become a regular feature of the procedure of patent practice until more than a hundred years later, and the filing with the application of a provisional specification describing the nature of the invention was especially adopted by the Act of 1852

March 1, 1651—The official series of English and British patents which begins with the year 1617 and is being continued to day, does not include any entries for the Commonwealth period, though several patents were granted during that regime Some of these were in the usual way by Cromwell's Letters Patent, but others were granted direct by Act of Parliament and not under the Great Seal One of these latter was to Jeremy Buck, of Minchinhampton, Glos, and dates from Mar 1, 1651 Like Sturtevant's referred to above, it is one of the many unsuccessful patents dealing with the use of coal for smelting iron The Act contains a proviso that, after seven years, Buck was to take apprentices and "teach them the knowledge and mystery of the new invention"

Societies and Academies.

LONDON

Geological Society, Jan 23—J K Charlesworth The South Wales end moraine The Irish Sea ice stood over Cardigan Bay at the period of the maximum advance of the Newer Drift period, and ponded back the natural drainage of northern Pembrokeshire and southern Cardiganshire to form a chain of extra-glacial lakes connected by marginal streams The end moraine of the Newer Drift passes across eastern and southern Wales In northern Pembrokeshire and southern Cardiganshire it was laid down along the edge of the Irish Sea ice Farther east, the moraine is practically continuous, and represents the marginal product of the local Welsh ice, which was centred in the mountains of Central Wales, the Carmarthenshire Vans, the Brecon Beacons, the Black Mountains, and the mountains of Radnor Forest This ice flowed beyond the outlets of the great valleys of the east to form the valley glaciers of the Severn and other rivers, and extended southwards on to the coastal plain of Glamorgan The Newer Drift is of early Magdalenian age—A Jowett and J K Charlesworth The glacial geology of the Derbyshire dome and the western slopes of the Southern Pennines The Derbyshire Dome of the Southern Pennines was over-ridden at the period of maximum glaciation by ice from the north and north west This is shown by the occurrence of patches of true boulder clay, by the wide distribution of erratics of Lake District and Galloway rocks over the dome and along its valleys, and other evidence The upper limit of the erratics from the north follows the outer flanks of the south-western Pennines at about 1250 feet above sea level The ice-recession from this position was associated with a copious marginal drainage, which eroded a well developed suite of channels linking a number of big extra glacial lakes in the valleys of the western Pennines

Physical Society, Jan 25—C Vernon Boys A fused quartz pendulum rod for clocks Possible causes of the progressively increasing losing rate found in the going of the Shortt clock are discussed A design is given for the free pendulum with rod of fused quartz, carbon steel and mild steel for the supporting springs and the bob respectively are suggested—G W Sutton A method for the determination of the equivalent resistance of air condensers at high frequencies The losses in air condensers are divided into two portions (a) those due to leakage through the solid dielectric, and (b) those due to terminal and plate resistance A method is developed for measuring each, under conditions such that the other is negligibly small—L Hartshorn The measurement of the anode circuit impedances and mutual conductances of thermionic valves A Wheatstone bridge method with current of telephonic frequency is used Although both anode circuit resistance and mutual conductance vary very considerably with the grid bias, the product of the two, which gives the voltage factor of the valve, is approximately constant The increase in the effective values of the inter electrode capacities is explained by the presence of the space charge, which also has the effects of making these capacities vary with the frequency and of giving them a comparatively high power factor, especially at low frequencies.

Linnean Society, Jan 31—Miss G H Faulkner: The anatomy and histology of bud-formation in the Serpulid, *Filograna implexa* The genus *Salmacina* is synonymous with *Filograna* The position of the plane of fission and the initial size of the bud are

variable, both being related to the length of abdomen of the stock Internal histological changes accompany the formation of the external form of the bud These result in a complete histolysis of the original tissues of the bud-segments and their replacement by embryonic cells —R W G Hingston The natural history of the Oxford University Expedition to Greenland in 1928 Godthaab was selected as the place for investigations Animal life is abundant, but the proportion of individuals to species is small The birds are more prolific than the corresponding species in temperate regions and their development is more rapid The Passerine birds laid on an average two more eggs in each clutch, and the fledgling periods were reduced by five or six days The Polar wolf and hare do not change into a brown coat in summer, because in summer, owing to the superfluity of food, there is no struggle for existence in the ordinary sense, and therefore no necessity for such change

PARIS

Academy of Sciences, Jan 21 —The president announced the deaths of M Widal, member of the Section of Medicine and Surgery, and M Riquier, *correspondant* of the Section of Geometry —**A Lacroix** The chemical composition of the tectites, and in particular of those of Cambodia —**Eduard Cech** Projective deformation of plane networks —**Paul Delens** Systems of two circles and groups of spherical operations —**L Lusternik** and **L Schnirelmann** A topological principle in analysis —**K Kunugui** The infinite and minimum type of dimension —**Krawtchouk** A theorem of Laguerre —**Henri Cartan** A new theorem of unicity relative to meromorph functions —**J Herbrand** The non contradiction of the arithmetical axioms —**W Margoulis** The experimental determination of the tensions in the frames of aeroplanes —**J Haag** The influence of the inertia of the spiral on the rate of chronometers —**Joseph Pérès** The action of an obstacle on a viscous fluid, a simple demonstration of the formulæ of Faxén —**J E Verschaffelt** The equation of van der Waals and thermodynamics Discussion of a recent communication on the same subject by V Karpen —**C Raveau** The principle enunciated by Carnot the theorem The formulæ of the second domain of thermodynamics independent of any principle —**B Decaux** The calibration of tuning-forks serving as a basis for the measurement of radiotelegraphic frequencies The method described permits of an accuracy of 3 in 100,000 —**V Dolejšek** and **Mlle D Engelmannová** The spark doublets in the K series —**J Gilles** The structure of the third order spectrum of sulphur —**H Volkringer** The continuous spectrum of mercury vapour —**Pierre Bricout** A spectrograph objective possessing a focal distance constant to a thousandth approximately between 1850 A and 7000 A The elements of a quartz fluorspar doublet are separated by a thin convergent meniscus of distilled water This gives an objective remarkably achromatic over the range of spectra for which a quartz fluorspar lens is commonly employed —**R Coustal** The realisation of a phosphorometer by means of which measurements of the intensities of phosphorescence can be rapidly carried out —**B Bogitch** A method for the electrolysis of nickel A description of an industrial method for preparing nickel electrolytically of 99 9 per cent purity from a nickel containing 10 per cent of impurities The electrolytic solution is a strong solution of nickel chloride heated to 65° C, the anode and cathode compartments are separated by a diaphragm, and fine nickel wires are used as the cathode —**Mlle. Suzanne Veil** The chromites and ferrites of nickel and cobalt —**Octave Mengel** The presence on the south slope of the Pyrenees of overthrust elements proceeding from a fold in the north —**Robert Perret** and **Léon Moret** The limits of the Bathonian in the Sixt Alps (Haute Savoie) —**H Baulig** The forms of relief in the central plateau of France and its Mediterranean border general results —**P Mazé** The determination of the temperature of the chloroleucites in maize plants exposed to the sun —**A Perrier** The transformations of chlorophyll in a green alga —**Max** and **Michel Polonovski** The aminoxides of hydrastine and of narcotine Hydrastine and narcotine oxidised with hydrogen peroxide give true N oxides these are unstable, and are easily transformed into compounds the nature of which is still under investigation —**C Vaney** and **A Bonnet** The phenomena of regeneration in *Spirographis Spallanzanii* —**Aversenq, Jaloustre,** and **Maurin** The action of thorium X on the proportion of active principles of certain medicinal plants Experiments are given showing that radioactivity is capable of producing a marked increase in the proportion of active principles of certain plants —**J André Thomas** The rôle of the grouping of individuals in the perturbations of tropisms of *Convoluta Roscoffensis* by some alkaloids —**L Hugounenq** and **E Couture** The action exercised on the photographic plate by cholesterol extracted from cod liver oil Cholesterol extracted from bile calculi, or from ox brain, has no action, even after several days' exposure, on a sensitive photographic plate Cholesterol extracted from cod liver oil, on the other hand, exposed on the same plates under similar conditions, causes the appearance of well marked black spots —**S Mutermilch** and **Mlle E Salamon** The vaccination of the rabbit against cerebral tetanus —**P Descombey** The antitetanus immunisation of the guinea pig by the intracerebral injection of tetanus anatoxin —**L Normet** The treatment of experimental hæmorrhage in the dog by an artificial serum containing citrates

ROME

Royal National Academy of the Lincei Communications received during the vacation —**G Fubini** The transformations of Laplace, Lévy, and Moutard for hyper surfaces —**F Zambonini** and **V Caglioti** The quantitative spectroscopic determination of small quantities of strontium, barium, and cæsium in minerals, rocks, natural waters, etc The method long in use for the determination of lithium and consisting in ascertaining at what dilution the characteristic red line of the spectrum just disappears, is applied to strontium, barium, and cæsium For the first two of these metals, the method requires absence of free acid from the solutions The presence of barium does not influence the spectroscopic determination of strontium, but calcium in marked quantity renders the results less exact Neither rubidium nor lithium affects the results obtained with cæsium, but if potassium is present in large proportion, the solution used for comparison should contain potassium in similar proportion Under such conditions, the method gives approximately exact results with materials containing as much as 10 per cent of cæsium —**G Aliprandi** The principal normals (according to Vitali) of a generic surface of Hilbertian space —**Silvia Martis in Biddau** The exponentials of matrices of the second order and their application to the theory of groups —**G Sansone** The equation which satisfies the coefficient a of the congruence $x^3+ax+a\equiv 0$ (mod p) with p prime —**R Calapso** A new transformation of isothermal surfaces With the help of the ready transformation of the R surface of Tzitzéica into an isothermal

surface of a four dimensional space, it was recently shown that the projective deformation of an R surface is reducible to a transformation C_m. A new transformation of the isothermal surface, of which that of Darboux is a particular case, is now established —**G Colonnetti** New contribution to the theory of elastic co-actions and its technical applications (3) The theorem enunciated and demonstrated in the two previous notes is applied to the solution of certain concrete problems of technical interest —**H Geppert** Adiabatic invariants of a differential generic system (3) The differential systems of two dimensions having been considered in the earlier notes, the more general case of the generic system of n dimensions is now discussed —**A Masotti** A form of the dynamic equations of a system of rectilinear vortices —**A Belluigi** Gravity measurements and isostasy —**A Ferrari and M Carugati** The importance of the crystalline form in the formation of solid solutions (4) Thermal analysis of the anhydrous systems $MgCl_2-FeCl_2$ and $CdCl_2-FeCl_2$. As would be expected from the similarity in crystalline structure of their components, each of these two systems exhibits complete miscibility in the solid state —**E Pace** Pinacones and pinacolines It has been previously shown that the action of organo magnesium compounds on γ diketones gives rise to ditertiary glycols, which can be readily transformed into hetero cyclic derivatives of tetrahydrofuran, tetrahydro pyrrole, and tetrahydrothiophen Similarly the α diketone diacetyl reacts with two molecules of magnesium alkyl halide, yielding α ditertiary alcohols (pinacones) which may be converted into the corresponding pinacolines by dehydration with dilute sulphuric acid and subsequent distillation in a current of steam Acetylacetone, the most important of the β-diketones, fails, however, to react with magnesium alkyl halides, due perhaps to the existence of acetylacetone as an equilibrated mixture of desmotropic forms —**L Settimj** Chemical composition of certain food pastes and the modifications effected by boiling in water In materials of the macaroni type, the starch granules are mostly somewhat distorted and in some cases exhibit deep fissures, the central hilum being always shown as a point After being boiled the granules are larger, the few that remain intact presenting undulating contours, the interior of the granules shows stratification and the central hilum resembles a vacuole The boiled substance contains about 20 per cent of soluble starch and 6 per cent of reducing sugars, and shows a marked diminution in the proportion of soluble nitrogenous materials —**P Di Mattei and F Dulzetto** Histochemical demonstration of glutathione and its distribution in certain organs To detect glutathione, the organs are reduced to small fragments and immersed for at least thirty minutes in 20 per cent trichloroacetic acid solution immediately after removal from the animal Sections 4 5 μ in thickness are cut by the freezing method, placed on microscope slides, and treated for 3 4 minutes with freshly prepared 5 per cent sodium nitroprusside solution The excess of the reagent being removed by means of filter paper, the slide is inverted over the open mouth of a bottle of concentrated ammonia solution An amaranth red coloration, appearing at once, indicates the location of the glutathione —**E Caroli** The microniscus phase of *Ione thoracica* (Montagu) obtained by culture on copepods

WASHINGTON, D C

National Academy of Sciences (*Proc*, Vol 14, No 11, Nov 15) —**Harlow Shapley** Studies of the galactic centre (1) The programme for Milky Way variable stars Five years ago an observing programme was arranged at Harvard Observatory to provide material for the general study of faint variables as bearing on the Milky Way problem The observations will be continued for another five or ten years and the results summarised under the above general title The problem is largely one of the improvement and extension of existing standards of magnitude —**Harlow Shapley and Henrietta H Swope** Studies of the galactic centre (2) Preliminary indication of a massive galactic nucleus Examination of the distribution with respect to median magnitude of twenty six cluster type variables in the field to the north of Ophiuchus and Scorpio, suggests a nucleus at a distance of nearly fifty thousand light years, which agrees with the distance of the galactic centre as determined from measurements of the globular clusters —**Gustaf Strömberg** The determination of absolute magnitude dispersion with application to giant M stars —**Arthur E Kennelly** Gudermannian complex angles These functions have many applications in physics and electrical engineering An outline table of complex gudermannians is given —**Nicholas A Milas** New studies in polymerisation (1) Polymerisation of styrene Benzoperacid increases the rate of absorption of oxygen in the initial stages of the oxidation of styrene and also the rate of polymerisation Anthracene inhibits polymerisation and also the oxidation of the benzaldehyde formed Yet in the presence of anthracene, oxidation of styrene proceeds at a relatively high rate, indicating selective inhibition Polymerisation seems to be effected by energy liberated by the initial products of oxidation reacting with unoxidised styrene molecules —**John R Bates** The quenching of cadmium resonance radiation Hydrogen quenches the resonance radiation, probably having its vibrational energy increased —**H C Sherman and H L Campbell** The influence of food upon longevity Using two diets, one of which, as shown by rates of growth and reproduction, is adequate, but the other is better, it is shown that the average duration of life of rats on the latter diet was almost ten per cent greater than those on the former diet —**Carl Barus** The interferometer U gauge with closed auxiliary reservoirs —**F S Brackett** Characteristic differentiation in the spectra of saturated hydrocarbons The vibration spectra in the near infra red were examined These give data as to the relative binding forces exerted upon the hydrogens when attached to primary, secondary, and tertiary carbons —**E O Wollan** Are characteristic X rays polarised? Using a method based on integrated intensity measurements, it is found that, within the limits of experimental error, the $K\alpha$ lines of molybdenum are not polarised —**J G Winans and E C G Stueckelberg** The origin of the continuous spectrum of the hydrogen molecule A theoretical discussion —**E U Condon and H D Smyth** The critical potentials of molecular hydrogen An examination of the experimental data on the lines of the preceding paper —**Jesse W M DuMond** The structure of the Compton shifted line Theory predicts that the shifted 'line' is a diffuse band Using scattering angles of 170° 178°, good agreement between observed and calculated structure was observed for scattering by aluminium, but additional lines appear with beryllium —**Stanley Smith** Some multiplets of doubly ionised lead —**Benedict Cassen**: Spectral intensities of radiation from non harmonic and aperiodic systems —**Joseph Kaplan** The aurora red line In experiments on the excitation of the auroral green line when oxygen is mixed with active nitrogen, a red line is observed This 'line' seems to be a

band belonging to the first positive group of nitrogen.—Ernest Merritt and William E Bostwick A visual method of observing the influence of atmospheric conditions on radio reception Partial separation of the effects of the direct and the 'reflected' waves is achieved by using two balanced receivers, one with its plane vertical and directed towards the sending station, and the other in the vertical plane and at right angles to this direction The coils are coupled with a local oscillator and made to actuate a cathode ray oscilloscope The vertical and horizontal movements of the oscilloscope spot correspond in amplitude and phase with the oscillations received by the two coils —Francis D Murnaghan On the energy of deformation of an elastic solid —Raymond R Willoughby The survival of intelligence

Official Publications Received

BRITISH

Royal Society of Arts John Street, Adelphi London W C 2 Cantor Lectures on Fatigue Phenomena, with Special Reference to Single Crystals delivered before the Royal Society of Arts during February 1928 By Dr Herbert John Gough Pp. 108 (London) 3s.

Indian Journal of Physics Vol 3 Part 2 and Proceedings of the Indian Association for the Cultivation of Science Vol 12 Part 2 Conducted by Prof C V Raman Pp 151 305 (Calcutta.) 3 rupees 4s

Annals of the (Mededelingen van het) Transvaal Museum Vol 12 Part 4 December 29 Pp 289 383 (Cambridge Printed at the University Press.)

Canterbury College (University of New Zealand) Records of the Canterbury Museum Vol 3 No 3 Pp 161 220+plates 24 37 (Christchurch N Z)

Journal of the Indian Institute of Science Vol 11A, Part 12 A Biochemical Study of some Soil Fungi with Special Reference to Ammonia Production By A. K. Thakur and Roland V Norris Pp. 141 160 1 rupee Vol. 11A, Part 13 The Atomic Weight of Antimony from different Sources By K. R Krishnaswami Pp 161 172. 1 rupee (Bangalore)

Proceedings of the University of Durham Philosophical Society Vol 8 Part 1 1927-1928. Pp iv+69+xi (Durham.) 5s

Catalogue of the Nineteenth Annual Exhibition of Electrical Optical and other Physical Apparatus January 8, 9 and 10, 1929 Pp. 142+xxvi (London Imperial College of Science.)

Transactions of the Mining and Geological Institute of India. Vol 23 Part 1, November Pp. 90+vi (Calcutta) To Members, 2 8 rupees, to non Members 4 rupees

Transactions of the Norfolk and Norwich Naturalists Society Presented to Members for 1927-28 Vol 12 Part 4. Pp. xvi+383-520 (Norwich) 10s

University College of Wales, Aberystwyth Welsh Plant Breeding Station The Effect of Nitrate of Soda on the Yield and Chemical Composition of a simple Seeds Mixture in the First Harvest Year By T W Fagan W E J Milton and Dr A L. Provan. (Series H, No 9, Seasons 1926-1927) Pp. 27+10 Tables. (Aberystwyth.) 3s. 6d

Proceedings of the Liverpool Geological Society Session the Sixty ninth, 1927-1928. Edited by C B Travis. Part 1 Vol. 15 Pp. xvi+109 (Liverpool.)

The Bulletin of the Hill Museum a Magazine of Lepidopterology Issued at the Hill Museum Wormley Witley Surrey Vol 2, No. 1 February 8th. Pp. 100+1 plate 15s Vol 2 No 2 June 18th Pp 101 182+22+4 plates 15s Vol. 2, No 3 November 17th. Pp 183-270+23-44+3 plates, 15s Vol 2 No 4 Index Pp. 271 296+vii (London John Bale Sons and Danielsson Ltd)

The Ramblers Federation Handbook being the Official Year Book of the Ramblers Federation (Manchester and District) for 1929 Pp. 80+9 plates (Manchester) 1s net.

Transactions of the Optical Society Vol 29 No 5, 1927-28 Pp. 197 260+xv (London.) 10s

Torquay Natural History Society Transactions and Proceedings for the Year 1927-8 Vol 5, Part 2 Pp. 81 174 (Torquay)

The Marine Biological Station at Port Erin being the Forty second Annual Report of the former Liverpool Marine Biology Committee now the Oceanography Department of the University of Liverpool Drawn up by Prof Jas Johnstone Pp. 80. (Liverpool) 1s. 6d. net.

Proceedings of the Royal Society of Victoria. Vol 41 (New Series), Part 1 Pp. iv+62+11 plates (Melbourne.)

Board of Trade. Second Report of National Fuel and Power Committee (Cmd. 3252) Pp. 46. (London H M Stationery Office) 9d net.

The Oxford Preservation Trust. Second Annual Report 1927-1928. Pp. 28. (London.)

FOREIGN

University of Illinois Engineering Experiment Station Bulletin No 187 The Surface Tension of Molten Metals. Part 2 A Determination of the Capillary Constant of Silver By Earl E Libman. Pp. 22 (Urbana, Ill) 15 cents.

Société des Nations Institut international de Coopération intellectuelle. Bulletin des relations scientifiques. 3e année, No. 4, décembre. Pp. iv+167 224. 8 francs. Index pour les années 1926 et 1927 (Nos. 1-6). Pp. 28. Index pour l'année 1928 (Nos. 7 10). Pp. 18. (Paris Les Presses universitaires de France.)

The China Foundation for the Promotion of Education and Culture Social Research Department. Second Annual Report. Pp. 8. (Peiping.)

Proceedings of the Imperial Academy. Vol. 4, No. 9, November. Pp. xxxi xxxii+519-568. (Tokyo.)

China Foundation for the Promotion of Education and Culture Factory Workers in Tangku. By Sung Ho Lin Pp xi+128+8 plates. (Peiping) 1 dollar

The Carnegie Foundation for the Advancement of Teaching Bulletin No 22 A Retirement Plan for Colorado Public Schools a Study made at the Request of the Colorado Education Association and the State Department of Public Instruction. By Howard J Savage and Edmund S Cogswell Pp. x+7 (New York City)

Ministry of Agriculture Egypt Technical and Scientific Service Bulletin No. 81 Seasonal Variation in Salinity of Nile Water in the Aswan Reservoir and at Rodah (Giza). By R Aladjem. Pp. 14+5 plates (Cairo Government Publications Office) 5 P T

Department of the Interior U S Geological Survey Bulletin 806-A The Pumpkin Buttes Coal Field Wyoming By C H Wedgemano R. W Howell and C E Dobbin (Contributions to Economic Geology 1928, Part 2) Pp. ii+14+5 plates 10 cents. Water-Supply Paper 591 Surface Water Supply of the United States 1924 Part 11 Pacific Slope Basins in California. Pp viii+448 50 cents. (Washington, D C. Government Printing Office)

Smithsonian Miscellaneous Collections Vol 81 No 3 Morphology and Evolution of the Insect Head and its Appendages By R. E Snodgrass (Publication 2971) Pp 158 Vol 81 No. 6 A Study of Body Radiation By F. B Aldrich (Publication 2980) Pp. 54 (Washington, D C Smithsonian Institution)

Actes de la Société Helvétique des Sciences naturelles 109e Session annuelle du 30 août au 2e septembre 1928 à Lausanne Pp. 183+295+54 (Aarau H R Sauerländer et Cie)

Conseil Permanent International pour l'Exploration de la Mer Rapports et Procès verbaux des Réunions Vol 57 Report of the Committee appointed by the Council to consider the Question of the Closure of the Moray Firth to Trawling Pp. xviii+288 (Copenhague Andr Fred Høst et fils)

CATALOGUES.

Bulletin des publications nouvelles 3e trimestre 1928 Pp. 32 (Paris Gauthier Villars et Cie)

Notes on Books No. 254 January Vol 18. Pp 99 120 (London Longmans Green and Co Ltd)

Watsons Microscope Record No 16 January Pp 32 (London W Watson and Sons Ltd)

Old and Modern Books English Literature Australasia, Canada Ireland (No. 24) Pp 54 (Newcastle upon Tyne William H Robinson)

Catalogue of Accessories for the Petrological Microscope and Mineralogical and Crystallographic Apparatus (Petrac 29) Pp. 20 (London James Swift and Son Ltd)

Catalogue of Science and Technology No 8 Annotated and Classified List of Rare and Standard Works on Exact and Applied Science Part 9 including 18 Engineering (Section 1) Pp 929 1016 (London Henry Sotheran and Co)

Vitamin Therapy a Concise Résumé of our Present-day Knowledge done in a form suitable for the busy Practitioner Pp. 16 (London The British Drug Houses Ltd.)

A Catalogue of Books published by the Syndics of the Cambridge University Press. Pp xi+202 (London Cambridge University Press)

The Salex Book of Lens Bargains Pp 48 (London The City Sale and Exchange, Ltd)

Taylors Bee Supplies, 1929 Pp 44 (Welwyn, Herts. E H Taylor Ltd)

Captain James Cook, 1728 1928 Pp. 16 (London Francis Edwards Ltd.)

Diary of Societies

FRIDAY, FEBRUARY 22

IMPERIAL COLLEGE CHEMICAL SOCIETY (in Main Chemistry Lecture Theatre Royal College of Science), at 5.—Dr F A Freeth The Qualifications of an Industrial Chemist.

ROYAL SOCIETY OF MEDICINE (Disease in Children Section), at 5.—Dr G Slot A Clinical Method of Estimating Cardiac Efficiency in Children and the Work of a Rheumatism Supervisory Centre.

PHYSICAL SOCIETY (at Imperial College of Science), at 5.—L. F Stanley The Construction and Calibration of a Sensitive Form of Pirani Gauge for the Measurement of High Vacua.—Prof C H Lees The Free Periods of a Composite Elastic Column or Composite Stretched Wire.—Dr A. Ferguson and J A Hakes A Capillary Tube Method for the Simultaneous Determination of Surface Tension and of Density.—Demonstration of a Standard Electrostatic Voltmeter and Wattmeter used for Measurements of Alternating Currents at Power Frequencies at the National Physical Laboratory by Dr E. H Rayner

INSTITUTION OF ENGINEERING INSPECTION (at Royal Society of Arts), at 5.30.—A. S Grunspan Specification Notes and Good Practice relating to Concrete and Reinforced Concrete Work

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (in Mining Institute, Newcastle upon Tyne), at 6.—Dr G W Todd The Relations between the Properties of Engineering Materials and their Ultimate Structures.

INSTITUTION OF ELECTRICAL ENGINEERS (London Students Section) (jointly with Institutions of Civil and Mechanical Engineers), at 6.15.—W Ford Standardisation.

ROYAL AERONAUTICAL SOCIETY (Students Section), at 6.30.—L. T Brown The Napier Lion Engine.

INSTITUTION OF LOCOMOTIVE ENGINEERS (North Eastern Centre) (at Hotel Metropole, Leeds), at 7.—G H. Taylor Reduction of Weight in Rolling Stock.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemical Section), at 7.—F H Terleski and others Discussion on The Manufacture of Toilet Soap and Glycerin

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—G Baker Electrical Precipitation

Royal Photographic Society of Great Britain at 7 —G C Weston Enlarging

West of Scotland Iron and Steel Institute (at Royal Technical College, Glasgow), at 7 —Dr W H Hatfield The Response of Steels at Elevated Temperatures

Blackburn Textile Society (at Blackburn Technical College), at 7 30.—W A Walsh Some Recent Improvements in Textile Machinery (Lecture).

Junior Institution of Engineers, at 7 30 —J Calderwood The Application of the Heavy Oil Engine to Yachts and Small Craft.

Institution of Production Engineers (at 83 Pall Mall), at 7 30 —The Story of a Sparking Plug

Royal Society of Medicine (Epidemiology Section), at 8.—Surg -Comdr S F Dudley Human Adaptation to the Parasitic Environment.

Royal Institution of Great Britain at 9 —Dr F A. Bather Illy Stars of the Sea How they fit their Surroundings.

Institution of Mechanical Engineers (Manchester Branch)

Todmorden Textile Society —S Taylor Winding and Warping (Lecture).

SATURDAY February 23

North of England Institute of Mining and Mechanical Engineers (Newcastle-upon Tyne), at 2 30 —F E Smyth Diamond Boring Applied to Tapping Drowned Areas Underground —H C Pawson Land Drainage —R G Lunnon The Laws of Motion of Particles in a Fluid —*Paper open for discussion* —Roof Control on Longwall Faces J F C Friend

Royal Institution of Great Britain, at 3 —Dr E Bullock Music in Cathedral and Collegiate Churches (III).

Hull Association of Engineers (at Technical College Hull) at 7 15 —K G Tidd Marine Refrigeration

MONDAY February 25

Institute of Actuaries at 5 —J Bacon An Experience of Assured Lives in the State of Mysore —L S. Vaidyanathan Mortality of Indian Assured Lives

Institution of Electrical Engineers (North Eastern Centre) (at Armstrong College, Newcastle upon Tyne) at 7 —R W Gregory Electric Supply to the Rural Districts of England

Royal Society of Arts at 8 —Sir Thomas M Legge Thirty Years Experience of Industrial Maladies (Shaw Lectures) (II)

Medical Society of London at 8.—Prof A H Burgess and C H S Frankau Acute Intestinal Obstruction

Royal Society of Medicine (Odontology Section) at 8 —W K Fry Fractures of the Mandible in and Posterior to the Molar Region

Cambridge Philosophical Society (in Botany School) at 8 45 —Dr A E Barclay Where Science and Medicine meet.

TUESDAY February 26

Royal Society of Medicine (Medicine Section) at 5 —Prof K Hansen The Psychical and Allergic Factors in Asthma.

Royal College of Physicians of London, at 5 —Dr J G Forbes Past and Present Diphtheria in England and Wales with Special Reference to the London Metropolis (I).

Royal Institution of Great Britain at 5 15 —Prof J S Huxley Evolution and the Problem of Species (V).

Institution of Electrical Engineers (East Midland Sub-Centre) (at Loughborough College), at 6.45 —J H R. Nixon Motor Converters

Institution of Electrical Engineers (North Midland Centre) (at Hotel Metropole Leeds), at 7 —R A. Chattock The Modern Use of Pulverised Fuel in Power Stations.

Royal Photographic Society of Great Britain (Scientific and Technical Group), at 7 —A. K. Tallent A Simplified Method of Screen Negative Making —R. E Owen Physical Development and the Nature of the Latent Image.

Institution of Engineers and Shipbuilders in Scotland (at 39 Elmbank Crescent, Glasgow), at 7 30 —Prof C H Desch The Deformation of Metals

Royal Anthropological Institute at 8 30

Royal Aeronautical Society (Leeds Branch).—N S. Norway Control of Rigid Airships.

Manchester Athenæum Textile Society —H Broadbent The Law of Contracts (Lecture).

WEDNESDAY February 27

Liverpool Engineering Society (at The Temple Liverpool) at 6 30 —Mr Woolnough Valves for Reciprocating Steam Engines

Institution of Automobile Engineers (Manchester Centre) (at Engineers Club, Manchester), at 7 —H Kerr Thomas Some Investigations into the Performance of Tubular Radiators for Motor Vehicles

Institution of Electrical Engineers (South Midland Centre) (jointly with Midland Centres of Institutions of Civil and Mechanical Engineers) (at Midland Institute Birmingham), at 7 —Capt J M Donaldson (Power Systems) J G Hines (Telephone Systems), and others Discussion on The Anticipation of Demand and the Economic Selection Provision and Layout of Plant

Institution of Welding Engineers (at Birmingham Chamber of Commerce), at 7 —C S Milne Welding and Cutting Practice with Low Pressure Plant.

Society of Chemical Industry (Glasgow Section) (at 39 Elmbank Crescent Glasgow) at 7 15 —Dr F S Sinnatt A Fuel Research Subject.

Halifax Textile Society (at White Swan Hotel Halifax) at 7 30 —Dr S. G Barker Alkaline Standards for Scouring and Effect upon Dyed Goods, etc. (Lecture)

Royal Society of Arts, at 8.—A F Suter Resins

Eugenics Society (at Royal Society)

Society of Chemical Industry (Newcastle-on Tyne Section) (at Armstrong College).—S A Wikner Tar Distillation (IV).

THURSDAY February 28

Institution of Municipal and County Engineers (South Midland District) (at Town Hall, Southall), at 10 4 a.m.

Royal Society at 4 30.—Sir Charles Martin and others Discussion on Ultra Microscopic Viruses infecting Animals and Plants.

Linnean Society at 5.—Symposium on the Occurrence of Natural Hybrids —Dr A. W Hill Hybridisation in the New Zealand Flora, with Special Reference to *Gaultheria* —B M Marsden-Jones and Dr W B Turrill Hybridisation in Certain Genera of the British Flora.—Prof C E Moss Some Natural Hybrids of *Clematis Anemone*, and *Gerbera* from the Transvaal.

Royal College of Physicians of London at 5 —Dr J G Forbes Past and Present Diphtheria in England and Wales, with Special Reference to the London Metropolis (II).

Royal Institution of Great Britain at 5 15.—Prof A O Rankine Physics in Relation to Oil Finding (II).

Biochemical Society Birmingham University at 5 30.—A. G Norman Immunity

Institution of Electrical Engineers, at 6 —Ll B Atkinson How Electricity Does Things (Faraday Lecture).

Royal Aeronautical Society (at Royal Society of Arts), at 6 30.—R. A Fraser The Flutter of Aeroplane Wings

Institute of Metals (Birmingham Local Section) (jointly with Birmingham Metallurgical Society and Staffs Iron and Steel Institute) (at Engineers Club Birmingham), at 7 —W A Benton Metallurgy and the Evolution of the Balance

Institution of the Rubber Industry (Manchester and District Section) (at St. Mary s Parsonage Manchester), at 7 —H. Page The Distribution of Compounding Ingredients in Rubber Mixings.—W H. Reece Chemical Reactions in Rubber Compounds (I) Litharge and Pine Tar

Institution of Automobile Engineers (Graduates Meeting) (at Royal Hotel Luton) at 7 30 —G Baston Some Notes on Gear box Design

Institute of Brewing (Yorkshire and North Eastern Section) (at Queen s Hotel Leeds).—R Seligman Applications of the Plate Heat Exchanger to Brewery Purposes

FRIDAY March 1

Royal Photographic Society of Great Britain (Pictorial Group) at 7 Informal Meeting

Society of Chemical Industry (Manchester Section) (at Engineers Club, Manchester) at 7 —Prof T P Hilditch Recent Advances in our Knowledge of the Structure of the More Common Fats

Institution of Electrical Engineers (Meter and Instrument Section) at 7 —W Lawson The Rotor Bearings of Electricity Meters.

North East Coast Institution of Engineers and Shipbuilders (Informal Meeting) (at Newcastle upon Tyne), at 7 15 —Sir Joseph Isherwood Bart and others Do the Rules of Classification Societies tend to improve Shipbuilding and Engineering in this Country?

Geologists Association (at University College), at 7 30 —S E Hollingworth Evolution of the Eden Drainage in the South and West —M Chatterjee The Accessory Minerals in the Bodmin Moor Granite.

Junior Institution of Engineers (Informal Meeting), at 7 30 —L S Atkinson The Control of Electric Lifts

Institution of Automobile Engineers (Graduates Meeting) (at 51 West Regent Street Glasgow) at 8.—E C Philbrow Inspection

Royal Institution of Great Britain at 9 —Sir Robert Robertson Infra Red Spectra

Electroplaters and Depositors Technical Society (Birmingham Conference on Chromium Plating)

SATURDAY March 2.

Royal Institution of Great Britain at 3 —Sir Ernest Rutherford Molecular Motions in Rarefied Gases (I)

PUBLIC LECTURES

FRIDAY, February 22.

London School of Economics at 5 —C E R. Sherrington Air Transport and the Disintegration of Economic Barriers

University College at 5 30 —Dr J H. Jones Hygiene of the Mercantile Marine (Succeeding Lectures on Mar 1 and 8.)

SATURDAY February 23.

Horniman Museum (Forest Hill) at 3 30 —Dr Bernard Smith Zermatt and its Glaciers

MONDAY February 25

King s College of Household and Social Science at 5.15 —J Bailey Preservation of the Countryside

East Anglian Institute of Agriculture (Chelmsford), at 7 —T Hacking The Law in Regard to the Sale of Milk

WEDNESDAY February 27

University College, at 5 —Dr J H Burn The Properties of and Methods of Estimating some Therapeutic Agents. (Succeeding Lectures on Feb 28 and Mar 1)—At 5 30.—J A Wilks Special Library Collections at University College

THURSDAY February 28.

Bedford College, at 5 15 —A. E Henderson Byzantine Architecture

University College, at 6.—W G Tarrant Estate Development and its Relation to Town Planning

SATURDAY March 2

Horniman Museum (Forest Hill), at 3.30.—Prof J R Ainsworth Davis English Food Past and Present

SATURDAY, MARCH 2, 1929

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The Place of Biology in School Science

ATTENTION has recently been directed by Mr Ormsby Gore and others to the lack of adequately trained men to supply the urgent needs of the Empire for biologists The need has existed for a long while but the position has never been dealt with in a comprehensive way possibly because there was no practicable method of awakening that general interest in the problem which is an essential prelude to its solution It may now be confidently said that interest is at last aroused and the time is ripe for attacking the problem itself There has been a highly significant change in the attitude of the average citizen to the multitudinous problems of Empire and he now realises how intimately he is concerned in the ordered development of over seas resources By its general activities and perhaps above all by its publicity campaign the Empire Marketing Board is driving home this new outlook while for some time past it has formed the guiding principle in official circles we need only instance the new organisation of the Dominions and Colonial Offices the reports of Commissions that have examined some of the problems in the non self governing Colonies the Research Grants Committee of the Empire Marketing Board the first Imperial Agricultural Research Conference and the personal visits of Mr Amery and Mr Ormsby Gore to the Dominions and Colonies The most important common factor brought out in all these activities is the opportunity for the trained biologist Innumerable problems await him in every form of agriculture in forestry and in education

There is little doubt that the grave shortage of qualified men would not have occurred had biology not been neglected in the school science course It is perfectly true that the small proportion of men destined by natural gifts to become leaders in some branch of science are little affected by gaps in their early training but the spade work on which the general orderly advance of a subject and its actual employment in practical problems closely depend is done by men of less transcendent qualities who form the bulk of the class of professional scientific workers These men are undoubtedly moulded to some degree by their early education in the sense that although they are evidently potential scientific workers the particular branch that they will follow usually depends on what was put before them in their impressionable years It is well to stress the vital control that the educational syllabus has in maintaining the supply of competent research workers in any branch of

science German physics and chemistry and their industrial applications provided the outstanding illustration of the pre-War period This achievement was once described by, we believe, Sir William Ramsay as "the triumph of the second rate" The phrase can be construed as cynical in intention, but its true meaning is surely that the success depended on adequate training for the mass of research workers, who were only second rate in comparison with the few men of genius

The science curriculum of British public and other secondary schools is almost exclusively occupied by formal physics and chemistry, and it is not surprising that recruits for other branches of science are relatively few Yet it is not easy to make any change, although the desirability of doing so seems evident The matter has been under careful examination by committees of the British Association, dealing respectively with "Science in the School Certificate Examination" and "Animal Biology in the School Curriculum" The former is naturally the more comprehensive, and makes a clear distinction between science teaching as part of a general education, and as preparation for professional qualification or a degree It is generally forgotten—and the recent correspondence in the *Times* is no exception—that only a very small proportion of secondary school pupils proceed to universities Probably 96 97 per cent finish their formal education at the age of sixteen, and the remainder have already begun to specialise in the subjects they intend to follow at the university or elsewhere

Both classes suffer through the almost complete neglect of biology in their curriculum The former class have not a properly balanced outlook on science and its manifold relations to the modern world, while in the latter class there are, as already mentioned, potential biologists who will nevertheless become physicists and chemists The scope and intention of the biological teaching—or better, of the balanced scientific teaching—must be different in the two cases, but obviously the primary need is that the science course in both the preparatory or elementary school and the secondary or public school shall contain an adequate amount of biology There would be little difficulty about this if our existing educational structure could be demolished and built afresh, for any attempt to graft additional subjects on to an already overcrowded curriculum is faced by grave difficulties On one hand there are the enthusiasts who would jettison something to make room, some suggest that non scientific subjects should be reduced others that physics, chemistry, and mathematics should be curtailed On the other hand, there are the (unkindly described) vested interests, who assert that the time available for science is already cut to the bone Meanwhile the vicious circle remains even if biological subjects were introduced to morrow, few qualified teachers could be found

It almost appears that the advocates of biological teaching have unwittingly delayed, by overemphasis, the reforms they have at heart, for they have created more than a suggestion that the present science teaching is out of touch with realities It is asserted that physics and chemistry courses have become more and more formal, that, for example, a lad may, and does, acquire a dexterity in dealing with weightless strings passing over frictionless pulleys, while entirely failing to appreciate the part that mechanics plays in his daily environment and in the functioning of his own body There is some truth in the statement, but the question whether it is a valid criticism needs a little closer examination If there is one thing essential in the present day civilisation, it is that those who live in it should be able to think accurately The more complex the environment the more must our actions be based on quantitative rather than qualitative reasoning The logical application of this axiom leads to a science syllabus in which physics and chemistry predominate, for these subjects, together with their servant, mathematics, are quantitative in their very essence, biology is not, and possibly may never be so, although a beginning has been made by applying the exact sciences, and biochemistry and biophysics already have great achievements to their credit Since physics and chemistry were first in the field, and in view of their quantitative nature, it is not surprising that they have been used almost exclusively in teaching the virtue of accurate reasoning

Another claim, recently expressed, is that education and biology can be defined in almost identical terms education is concerned with the living individual and the habitat in which he must live and work out his destiny, biology deals with the nature of living things and the relations to their environment Expressed in this way, the definitions seem at first sight interchangeable, but in reality the latter one is the narrower In the sense in which they are used above, the word 'habitat' has a much wider significance than 'environment' The human habitat includes the whole range of uses that man has made of inanimate Nature, and it is precisely these achievements that are of most interest to the educated man to day The reason

is not far to seek They give him a faint glimpse of the illimitable and amazing powers that his descendants may wield, and, on a more mundane plane, they contribute greatly to his material security, his comfort, and his recreation

There is a tendency for the exponents of biological teaching to assume that these immediate material benefits conferred on our civilisation by the applications of physics and chemistry have been responsible for the concentration on these subjects in the schools Proceeding from this assumption, the argument states that they continue to be taught partly from inertia, but also because they are a useful accomplishment in seeking a living, and by way of emphasis it concludes with the statement that if men were still bought and sold as in slavery times, human biology would possess equal importance But both the assumption and the argument are unsound, as to the assumption, the most commercially minded physicist has not lost his sense of wonder that a few pieces of wire, put together in a certain manner, should enable him to hear the voice of a fellow-man thousands of miles away, and as to the argument, cattle have been bought and sold for a long time, but it cannot be said that the breeders make much use of modern animal biology Wherever we look we find the same dominance of the physical world As an example we may take the yearly attendance figures for the Natural History and Science Museums, and now that each is in a permanent building the comparison is a fair one The number of visitors to the Natural History Museum has exceeded the half million mark each year since 1924, and shows perhaps a slight tendency to increase The attendances at the Science Museum have risen from 430,000 in 1925 to 709,000 in 1927, while the 1928 figure just exceeds 900,000

To take a lighter illustration, the twenty-fifth anniversary of the first flight of the brothers Wright was celebrated by a dinner under the wings of the historic biplane, attended by pioneers in the art and science of aeronautics, but no similar tribute was offered to the pterodactyl even at the centenary of Cuvier's elucidation of its true nature

We have to face the fact that the average citizen is not intensely interested in the biological nature of his own existence, and yet it is highly desirable that he should be Hence the introduction of biology into primary and secondary education must be achieved in the face of a certain apathy, coupled with protests both from the commercially minded and those educationists who fear a loosening of discipline in science teaching.

Apathy will disappear in proportion as interest is aroused When the opportunities for biologists in the overseas Empire and at home are fully appreciated by schools and by parents, any objections on the ground of unsuitability as a preparation for a professional career will disappear In this connexion we hope that the authorities will arrange for the widest possible distribution of two leaflets prepared by direction of the Imperial Agricultural Research Conference These deal with the opportunities for students of biology, one is addressed to teaching authorities, the other to parents and students, and both set out in moderate terms the bright prospects for some time to come for able young biologists The final hurdle, however, is the most formidable, it is to persuade a well-entrenched system of science teaching, conscious of its intellectual and utilitarian value, and proud above all of its value as a mental discipline, that it is nevertheless incomplete without biology How is this to be done? Bateson himself supplied the answer in his article in the Huxley Centenary issue of Nature "No one better than Huxley knew that some day the problems of life must be investigated by the methods of physical science if biological speculation is not to degenerate into a barren debate"

There would be few to dispute that primary science education should concentrate on the simplest—we might almost say the picturesque—aspects of Nature, and here the various phases of biological science naturally predominate But for the next stage, the secondary or public school period, the pupil must be brought into closer touch with realities, and the discipline of exact and critical thinking must be firmly established For this purpose it appears inevitable that wherever possible the approach to biology must be through the medium of physics and chemistry, although the subject must naturally be presented in proper perspective, and in some of its more complex branches only qualitative methods of exposition will be possible for some time to come

The consent of educationists to this outlook would be tantamount to accepting a course in general science as the backbone of pre-university teaching The foundation of the course would still be physics and chemistry, but it would also include studies of living things and of the changeful earth generally Its value as a mental discipline need not be reduced, and its human interest would be greatly increased The net would be thrown wider, and it would assuredly produce a greater number of recruits for biology than the present system

Pure Substances their Preparation, Properties, and Uses

La notion d'espèce en chimie Par Prof Jean Timmermans Pp iii + 134 (Paris Gauthier-Villars et Cie, 1928)

PROF TIMMERMANS has chosen as a basis for his monograph on "Chemical Species" the definitions given by Wald in 1897, and used by Ostwald in 1904 in the Faraday Lecture in which he tried to show that the molecular theory had become a superfluous hypothesis in view of the rapid development of the applications of thermodynamics to chemistry According to these definitions, a *chemical compound* is merely a 'hylotropic' substance which remains constant in composition over a range of temperatures and pressures, within which it resists all attempts at fractionation A *solution*, on the other hand, may remain of constant composition when attempts are made to fractionate it by a single method, for example, by distillation under a given pressure, but generally begins to break up when a second process of fractionation is tried, for example, by fractional distillation under a different pressure, or by freezing If, however, the material remains hylotropic and resists fractionation under all available conditions, it is classed as an *element*

These definitions appear to be strictly logical, but do not provide an immediate solution of the practical problem of recognising a chemical compound Thus it is not easy to say under what physical conditions stable oxides such as magnesia or alumina begin to dissociate into their components, although a schoolboy could prove their complexity by a synthetic method In cases such as these, the attempt to find a physical definition of a chemical species seems to lead to less satisfactory results than the traditional chemical methods

A converse difficulty arises in the case of substances which undergo isomeric or polymeric change Their behaviour then depends entirely upon the velocity with which this change takes place If the change is slow, the two substances will behave as distinct species, and can be fractionated in the ordinary way, provided that the process of fractionation is fast in comparison with the velocity of change Since, however, this velocity is often increased enormously by the presence of catalysts, it may be necessary to take exceptional precautions to maintain the purity of the sample, for example, by using silica containers in order to avoid contamination by the alkali of a soft glass vessel If these precautions are not taken, or if the velocity of change is inherently fast, the two species will behave as one, and no process of fractionation will be of the slightest use unless it can outrun the isomeric or polymeric change Substances of this kind will be hylotropic under all conditions, except those which give rise to a fundamental decomposition The hylotropic phases, if liquid or gaseous, will be equilibrium mixtures of the different species, but if a solid phase crystallises out, it will generally consist of a single species, since separation of the first crystal from the liquid or gaseous phase is immediately followed by a restoration of equilibrium, which results ultimately in a complete conversion into the solid species of lowest vapour pressure

It is necessary to lay stress on the complete breakdown of the usual criteria in cases of this type and to assert as clearly as possible that merely negative evidence has no value as a proof of molecular uniformity Thus the author cites Sidgwick's test for distinguishing between isomers and polymorphs, by observing whether an increased concentration is produced by saturating a solvent with both solid phases If an increase is observed, the difference between the two solids is evidently maintained in the liquid phase and by definition the two forms cannot then be mere polymorphs, but Prof Timmermans falls into a common error by quoting a case in which no increase of solubility is observed, and concluding from this evidence that "the two substances are polymorphic forms of the same compound " On the other hand, if one form is colourless and the other coloured, or if the two forms show a marked difference of colour, it can generally be asserted with some confidence that they are probably different species, even if their saturated solutions are identical in concentration, refractive index, optical rotatory power, etc, since it is unlikely that any mere rearrangement of the crystal lattice will suffice to produce a coloured aggregate from molecules which are colourless when packed in a different way The only logical conclusion in such a case is to treat the coloured and colourless molecules as different species, but to assign a high value to the velocity of transformation

It is indeed impossible to be quite certain that any given case of polymorphism may not be accompanied by molecular transformation, although this is less likely to occur in the case of an element, such as iron, where the molecules appear to be composed of single atoms which cannot be accused of any tendency to undergo changes of this kind. The fact that the interconversion of white and

grey tin is complete, whilst that of the two dichloroethylenes is reversible, does not depend, however, on the fact that the two forms of the element are polymorphic, whilst those of the organic compound are isomeric (as is suggested in the text), but on the fact that the former are solid, whilst the latter are liquid

The practical work of determining the physical properties of pure substances is a task to which Prof Timmermans has devoted himself for some years, and on this subject he can now speak with unrivalled authority In this respect he is the principal upholder of the British tradition of exact physico-chemical measurement, which he inherited as a student of Prof Sydney Young, and can also claim the privilege of having worked under Prof Kamerlingh Onnes at Leyden and under Prof Ph Guye at Geneva

The difficulties of this work are twofold, since its value depends equally on chemical purity and accurate physical measurements, and there are not too many data which are above reproach in both respects Thus, on one hand, it is necessary to write down as mere approximations the ordinary data as to the properties of organic compounds, such as melting-points determined with uncalibrated thermometers, often without any correction for the exposed stem , but it is equally clear that precise physical determinations of the physical properties of creosote (the only example of magnetic rotatory dispersion cited by Drude), or of hydrocarbons separated from petroleum by fractional distillation, have no greater claim to accuracy Whilst, therefore, the first part of Prof Timmermans' monograph deals, as it should, with the theoretical difficulties which are met with in trying to define a chemical species, the second and third parts deal with the practical problems encountered in preparing pure substances and determining their physical properties

It is not necessary to repeat here the valuable advice, and the equally necessary warnings, which are now given, since those who are interested in similar work would be well advised to read the words of the author rather than a paraphrase by the reviewer A more useful purpose may therefore be served by directing attention to the valuable service rendered by the Bureau International des Étalons Physico-chimiques, of which Prof Timmermans has been the director since 1922 This bureau, although financed largely by Belgian industrial chemists (and notably by the firm of Solvay et Cie), also forms a permanent part of the activities of the Union Internationale de la Chimie, ranking alongside the commissions which are responsible for preparing the Tables of Atomic Weights and the Annual Tables of Numerical Results It is indeed one of the functions of the Bureau to fill up the gaps in the existing tables of physical constants , but this is being done in a systematic rather than in a piecemeal manner by preparing various series of pure organic compounds, such as the hydrocarbons and their halogen derivatives, the alcohols, ethers, oxides, ketones, and aldehydes of the fatty series, and then determining for each compound the boiling-point (to $\pm 0.05°$) and its variation with pressure in the neighbourhood of 760 mm , the freezing-point, the critical solution temperature, the density at 0°, 15°, and 30° C , and the coefficient of expansion, the indices of refraction at 15° for eight different rays, with their temperature coefficients, dispersion, and molecular refraction The data thus obtained are compared critically with all the earlier measurements that are available, and are submitted to correspondents (of whom the reviewer is one) in each of the countries represented in the Union Internationale before being printed, with the result that in the course of the next five years there should become available an unrivalled series of standard measurements on a wide range of pure substances

These data can then be used, on one hand, as a means of testing the purity of samples prepared and used all over the world, since a sample of benzene, or cyclohexane, or ethylene bromide which melts at a lower temperature than that finally adopted as correct cannot be regarded as adequately purified On the other hand, the physical constants of the pure compounds can be used in the calibration of instruments of measurement in any laboratory, however remote This applies not only to thermometry, where the fixed points are almost always determined in this way, but also to calorimetry, where the water capacity of the instrument can be checked by the combustion of pure benzoic acid, and to measurements of viscosity, surface tension and the like, where absolute calibration is difficult or impossible in an apparatus of normal type

In view of the latter method of using pure substances, the Bureau des Étalons has undertaken to supply standard materials for calorimetry, refractometry, viscosimetry, and thermometry (both at high temperatures and down to $-160°$ C), and proposes to add to this list suitable substances for the calibration of measuring vessels at low temperatures, of manometers and potentiometers, and, in addition, to extend the scope of its work

by including inorganic as well as organic substances These materials can be procured from the Director, Bureau des Étalons, Université de Bruxelles (Solbosch), Belgique, and, by a reciprocal arrangement, materials purified by the Bureau of Standards in Washington can be purchased from the same address, whilst the Belgian products are also available in Washington T M Lowry

Illumination in Mines

Mine Lighting By Dr J W Whitaker (Monographs on Coal Mining) Pp xvi + 200 (London Methuen and Co , Ltd , 1928) 8s 6d net

Dr WHITAKER'S little book has been published at a very opportune moment, for the attention of all connected with coal mining is becoming increasingly focused upon the question of underground illumination The fact was clearly brought out at the recent annual meeting of the Institution of Mining Engineers, where one of the most important of the papers presented, and one which gave rise to a particularly keen discussion, was devoted to this subject

Quite apart from the undoubted fact that in the mine, as everywhere else, no man can possibly do efficient work unless he is supplied with an adequate amount of light to enable him to see clearly the work upon which he is engaged, in coal mining there is the additional consideration that, in the opinion of Dr J S Haldane, Dr L T Llewellyn, and other authorities, that very distressing and troublesome disease, miner's nystagmus, is due essentially to deficient lighting It is quite true that other medical men have contested this opinion and have brought forward other possible causes, but so far the weight of opinion, strongly supported by the findings of the Nystagmus Committee, inclines to the view that the cause is as above stated, and the author of the book now before us seems to share this view

It is well known that in the vast majority of collieries in Great Britain it is necessary to employ only safety lamps It is also well known that when safety lamps were first devised, it was the importance of safety that was mainly stressed in the first instance, and it was only later, when the conditions of safe light were thoroughly understood, that the amount of illumination received attention How greatly this question has been overlooked until quite recently may be gathered from the Government memorandum on " The Test of Safety Lamps," published in 1912, in which the only photometric test exacted from flame safety lamps is that the lamp is required to give a minimum candle-power of 0 30 during a period of ten hours It is now generally admitted that the miner requires at least ten times as much light as is imposed by the above Government legislation

There is still a great deal of ignorance on the subject of mine lighting, even amongst the most progressive colliery managers, and Dr Whitaker's little book should go far to dispel this ignorance, because it places in the hands of the colliery manager a small, clearly written, and very complete work on the subject The author commences by explaining the properties of light, and then proceeds to the units of photometry and a description of various photometers, it is to be regretted that amongst these he has not included the very simple but quite efficient photometer recently devised by Drs Haldane and Wheeler A chapter is devoted to a description of the eye and a discussion of vision, whilst the nature of miner's nystagmus is also discussed Considerable attention is devoted to the history and development of the flame safety lamp, then come chapters describing various types of electric lamps, whilst another chapter is devoted to acetylene mine lamps, and another useful chapter deals with the arrangement and operation of colliery lamp rooms

In the chapter on acetylene mine lamps no mention is made of the fact that acetylene safety lamps have been made and put on the market, although it is quite true that they have not met with any general acceptance Under the heading electric lamps, cap lamps are certainly discussed, but it may well be said that they have received less attention than their importance appears to warrant

Perhaps the most serious omission in the book is that the flame lamp is considered only as an illuminating appliance and its other very important function, namely, that of a detector of fire damp, is not considered No doubt the author could be justified in claiming that this consideration lies outside the scheme of his work, but in fact it is very difficult to divorce the two uses of the flame safety lamp from each other There is little doubt that if the electric safety lamp were as capable of being used for gas detection as is the flame safety lamp, it would long ago have displaced the latter, and the flame safety lamp only holds its own on account of its value as a gas detector Great efforts have recently been made to improve the illuminating power of the flame safety lamp, so as to enable it to compete on this score with the electric lamp, but it is still too early to say whether

these efforts will or will not be attended with success If such an improved safety lamp can be produced without at the same time impairing its value as a gas detector, there is little doubt that it would be preferred to the electric lamp, and everyone interested in coal mining sincerely hopes that such an improvement may be the outcome of the experiments that are now being carried out

If such advances are actually made, Dr Whitaker will no doubt take care to chronicle and describe them in a future edition Meanwhile it can only be said that this work offers a safe guide to all interested in this important subject, and is worthy of careful study by all engaged in colliery work

Archæological Discovery in China.

Archives de l'Institut de Paléontologie humaine Mémoire 4 *Le paléolithique de la Chine* Par M Boule, H Breuil, E Licent et P Teilhard Pp viii + 138 + 30 planches (Paris Masson et Cie, 1928) 160 francs

THE archæological discoveries in China of Fathers Teilhard de Chardin and Licent, of which a preliminary account appeared in *L'Anthropologie*, T 35, p 201, 1925, are the subject of a magnificently illustrated memoir written in collaboration with MM Marcelin Boule and H Breuil, which is now published by the Institut de Paléontologie humaine The reverend fathers are responsible for the narrative account of the investigations at the palæolithic sites of Choei tong keou and Sjara-osso gol, and the description of the worked quartzite implements from the base of the loess, while M Boule deals with the palæontology in collaboration with P Teilhard and also contributes an introduction, and H Breuil examines the implements from each site in detail The investigations which have produced the important results here described were undertaken at the instance of the Institut, which sent P Teilhard to China in search of evidence bearing upon the antiquity of man in Asia The prescience which directed and sent out the mission has been fully justified The results, now that they have been placed in their proper perspective by careful scrutiny in the laboratory of the Institut, are of first-rate importance

On geological and palæontological grounds, the pleistocene of China is equated with that of Europe It would appear that the range backward in time of the loess has been much over-estimated and that preceding conditions in China and Europe may be regarded as very much the same The fauna are strictly comparable both in time and character, the differences, notably in the predominance of the gazelle type, being due to climatic and geographical conditions There would thus appear to be adequate ground for the inference that in pleistocene times there was a continuity of conditions in Europe and Asia extending from China to Central Europe and even to France

For prehistory this is a conclusion of first rate importance, not merely in the equation of palæolithic man in Europe and in China, but also in certain consequential inferences The Chinese industries were advanced Mousterian—Early Aurignacian Not only are early Palæolithic types entirely absent, but notwithstanding the Mousterian types, the characterisation of the industry as a whole is Upper Palæolithic Again, the two sites are not identical, the most noticeable difference being the higher number of microlithic implements at Sjara osso gol, where they were about a third of the implements found In the absence of comparable stratigraphic evidence it is impossible to say if this indicates a later phase Probably it does not, but is due entirely to local conditions The Abbé Breuil thinks it may represent an ethnic or tribal distinction However that may be, in the main feature the two sites agree—the conjuction of various Palæolithic types which in western Europe would belong to different periods M Boule compares the Siberian sites, and, having these in view, it is suggested that Asiatic conditions must not be judged by a test which may apply only to the special circumstances of western Europe M Boule puts forward the view, and in this he is followed by his collaborators, that Asia was a vast workshop in which the stone industry was elaborated It was in advance of Europe at corresponding epochs of time, while the precise differentiation of the various industries in Europe demonstrated by the stratification was due to successive migrations from the common source

It cannot be denied that this theory is attractive and that there is much to be said for it Nor must too much store be laid upon the absence of early types of implement when so much remains unexplored Yet if the East Anglian evidence be accepted, it does seem singular that the earliest handiwork of man or his predecessor should appear in western Europe Now that parity of conditions has been established in China, we may perhaps expect to hear of evidence which previously has been overlooked through failure to appreciate the circumstances

Our Bookshelf

Introduction à la théorie des quanta les équations de la mécanique et de l'électronique Par Dr Marcel Boll et Charles Salomon (Collection de Physique et Chimie) Pp xx + 457 (Paris Gaston Doin et Cie, 1928) 85 francs

ANYONE who opens this admirable book expecting to find in it a discussion of the quantum theory will be completely disappointed After some fifteen introductory pages the quantum theory is practically never mentioned But such a reader's disappointment will be his own fault There is still no proper introduction to the quantum theory other than a thoroughgoing study of classical mechanics and electrodynamics This book contains a really excellent account of these subjects, aimed, as the authors say, at subsequent study of the quantum theory

The subjects are studied, as they should be, on their own merits, but the emphasis and choice of material has been influenced by the needs of the student of the quantum theory We have met no better introductory work on general dynamics and electrodynamics to put into the hands of a student who desires to approach the quantum theory with a substantial knowledge, not a mere smattering, of these important subjects During a first reading the treatment of almost every section seemed good and complete, with the exception of that on the difficult theory of the adiabatic invariance of the action variables of a multiply periodic system The difficulty introduced by accidental degeneracies during the change of parameter seemed not to be fully faced, though there is a summary of the important work of von Laue

The book can be heartily recommended as *the* book for physicists on general dynamics

R H F

Elementary Organic Chemistry By Homer Adkins and S M McElvain (International Chemical Series) Pp xi + 183 (New York McGraw Hill Book Co, Inc, London McGraw Hill Publishing Co, Ltd, 1928) 11*s* 3*d* net

THIS book was written to supplement a short course in organic chemistry given at the University of Wisconsin, and in consequence does not appear to be complete in itself or to agree with the inclusion of 'Elementary' in its title The beginner would be bewildered by the number of compounds dealt with in rapid succession in the first chapter of some 32 pages, and in the subsequent chapters the usual procedure is to consider a homologous series in a very general manner with only the briefest reference to the most important members of the series, or in some cases to omit them completely Thus in the chapter on aldehydes and ketones, acetone is not even mentioned

The authors have laid great stress on structural formulæ, which are printed in large type (in fact, the reaction showing the formation of fluorescein occupies nearly a page), and spend considerable time on nomenclature, which is so often neglected in elementary text-books, but unfortunately these are almost the only points in favour of the book, as it could not be used by a beginner unless to supplement some course of lectures, and then only if these followed the general arrangement of the book

J R H W

Bells Thro' the Ages the Founders' Craft and Ringers' Art By J R Nichols Pp xi + 320 + 53 plates (London Chapman and Hall, Ltd, 1928) 21*s* net

To meet the revived interest in bells, and because most of the books on the subject are out-of-print or inaccessible, Mr Nichols, himself a member of the Ancient Society of College Youths and the Lincoln Diocesan Guild, has written this study of bells and bell-ringing In his view, the period in the seventeenth and eighteenth centuries which has been called the 'Golden Age of Bell-founding' is in danger of losing its claim to that title owing to the activities of modern founders Be that as it may, his volume will be welcome to the practitioners of the art and those whose interest in the subject calls for a convenient book of reference

Mr Nichols' treatment of the subject on the historical side is comprehensive Not only are famous bells described in detail, but also he deals with the history of the methods of ringing, the peal, the chime, the changes, and so forth, famous founders, inscriptions and decorations on bells, and of course with the carillon A chapter is devoted to lore and legends—a subject which requires a whole book to itself, and certainly a broader treatment than Mr Nichols has given it To dismiss the belief that bells drive away evil spirits as a mere superstition, misses the significance of the importance attached to the bell in the early Christian Church as shown especially in the lives of the Irish saints

Sir Joseph Banks and Iceland By Halldór Hermannsson (Islandica an Annual relating to Iceland and the Fiske Icelandic Collection in Cornell University Library, Vol 18) Pp x + 99 + 27 plates (Ithaca, N Y Cornell University Library, London Oxford University Press, Copenhagen Andr Fred Höst and Són, Reykjavík Bókaverzlun Sigfúsar Eymondssonar, 1928) 15*s* net

SIR JOSEPH BANKS's visit to Iceland was in the summer and autumn of 1772, a time when comparatively little about that country was known in Europe He published nothing on his journey, but it is clear a good deal of scientific work was done Banks kept a diary, which can be traced as having been in the keeping of his wife's family until it was sold among his other papers in 1886 The present owner is unknown Mr Hermannsson has put this work together from various sources, and illustrated it by pictures from Iceland which were made at the time and are now in the British Museum Banks's visit was brief, but it awakened in him a lifelong interest in Iceland Much of the book traces through Banks's letters this interest, and his efforts on behalf of the Icelanders at a period when their fortunes were low.

Letters to the Editor.

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The Mass-Spectrum of Uranium Lead and the Atomic Weight of Protactinium

IT will be recalled (NATURE, Aug 13, 1927) that the identification of the isotopes of ordinary lead was made by means of a sample of its tetramethide kindly supplied to me by Mr C S Piggot, of the Geophysical Laboratory, Washington He has since succeeded in the much more troublesome task of preparing the similar compound of a rare uranium lead from Norwegian bröggerite His reasons for this work have already been published (C S Piggot, "Lead Isotopes and the Problem of Geologic Time," *Jour Wash Acad Sci*, May 19, 1928) The first tube of uranium lead methide despatched to me a year ago was unfortunately broken in transit, but the second reached Cambridge safely last summer At that time I was endeavouring to work out a photometric method of measuring the relative abundance of isotopes This work is by no means complete, but has recently reached a stage which justified an attempt on the mass spectrum of this very precious material The procedure was the same as with ordinary lead methide, but the general conditions of the discharge tube, etc, were not so favourable, so that the spectra obtained are weaker

The mass spectrum consists of a strong line at 206, a faint one at 207, and a still fainter one at 208 The last is barely visible to the eye, but easily distinguishable on the photometer curves The impossibility of eliminating mercury limits the search for lighter isotopes, but there is not the least indication of 203 or 205 Unfortunately, the experimental conditions all conspire to make the determination of the true relative intensities of the lines from the curve of photometer wedge readings too complex to be really trustworthy Calling the intensity of the strong line 100, the mean of the best plates gives $10\ 7 \pm 3$ and $4\ 5 \pm 2$ for 207 and 208 respectively As the only curve available for transforming wedge readings into intensities is one derived from krypton, these figures are probably both too high They correspond to percentages 86 8 9 3 3 9, and as the packing fraction is indistinguishable from that of mercury ($0\ 8 \times 10^{-4}$), the mean atomic weight deduced is 206 19, rather higher than that determined chemically for other uranium leads These figures have been communicated to Mr Piggot, and when combined with the analyses of the mineral should enable its age to be fixed with considerable certainty

There is, however, another point of view from which these results are of fundamental interest in connexion with the radioactive elements The line 207 is of peculiar significance It cannot be due to the presence of lead as an impurity, for in ordinary lead 208 is about twice as strong as 207, neither can it be the product of radium or thorium It is difficult to resist the natural conclusion that it is the end product of the only other known disintegration, namely, that of actinium If this is so it settles the mass numbers of all the members of this series, that of protactinium being 231 Extrapolation of the packing fraction curve suggests an atomic weight on the oxygen scale of 231 08

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Cambridge, Feb 16

Origin of Actinium and Age of the Earth.

BY the kindness of Dr Aston, I have had the opportunity of inspecting his photographs showing the isotopes of lead obtained from the radioactive mineral bröggerite As he concludes, it seems highly probable that the isotope of mass 207 is mainly due to actinium lead, and that the actinium series has its origin in an isotope of uranium—a suggestion independently put forward by several investigators on other evidence Since six α particles are emitted in the successive changes from protactinium to the end product actinium lead, the atomic weight of protactinium should be 231 The direct determination of the atomic weight of this element number 91 now in progress in the laboratory of Prof Hahn in Berlin should afford a crucial test of the accuracy of this deduction

In the light of this new knowledge and of the measurements made by Dr Aston of the relative intensities of the lead isotopes in the mineral, it may be of interest to consider its bearing on the origin of actinium and other problems We shall first discuss the probable mass of this new isotope, which for convenience will be called actino uranium It seems simplest to suppose that its mass is 235, and that it undergoes first an α and then a β ray transformation into protactinium The β ray body is probably to be identified with uranium Y, discovered by Antonoff, which has generally been regarded as the immediate parent of protactinium On this view, the successive transformations follow the order $\alpha\beta\alpha\beta$, where the α and β changes alternate, and differ in this respect from the main uranium series which follow the order $\alpha\beta\beta\alpha$ It is of course possible to assume that actino uranium has a mass 239 and number 92, and is converted into a mass 235 of number 92 in consequence of an α ray change followed by two β ray transformations, but no evidence has been obtained of the existence of such β ray bodies, although a careful search has been made for them by Hahn and others

An estimate of the period of transformation of the new isotope of uranium can be deduced on certain probable assumptions The ratio K' of the number of atoms of actinium lead to those of uranium lead can be deduced approximately from Aston's measurements, and we also know the ratio K—about 3/100—of the number of atoms delivered in a mineral into the actinium series compared with the number passing into the radium series If λ_1, λ_2 are the constants of transformation of actino uranium and the main uranium isotope respectively, it can easily be deduced that $K'/K = \frac{\lambda_2}{\lambda_1} \frac{e^{\lambda_1 t} - 1}{e^{\lambda_2 t} - 1}$, where t is the age of the mineral from which the lead is derived We shall suppose for the purpose of calculation that t is 10^9 years—an average estimate of the age of old primary uranium minerals Taking as a low estimate that $K' = 7/100$, it can be deduced from the equation that $\lambda_1/\lambda_2 = 10\ 6$ Since the *half-value* period of transformation of uranium is $4\ 5 \times 10^9$ years, it follows that the period of actino uranium is $4\ 2 \times 10^8$ years A larger value of K' lowers the period, while a higher value for the age of the mineral raises it

Taking the period as $4\ 2 \times 10^8$ years, it is seen that the amount of actino uranium is only about 0 28 per cent of the main uranium isotope—an amount too small to influence appreciably the atomic weight of uranium as ordinarily measured The amount of actino uranium at the time of its formation taken as 10^9 years ago comes out to be 1 44 per cent

There is another interesting deduction that can be made from these estimates It is natural to suppose that the uranium in our earth has its origin in the sun,

and has been decaying since the separation of the earth from the sun From the work of Aston, it is known that with two exceptions the most abundant isotope in an even numbered element is of even atomic weight If it be supposed that uranium, like other heavy elements, is formed from stellar matter, it is likely that actino uranium of odd atomic weight would be formed in smaller quantity than the main isotope of even atomic weight Even, however, if we suppose they were formed in equal quantity, it can be shown that it would require only $3 4 \times 10^9$ years to bring down the amount to the 0 28 per cent observed to day

If we suppose that the production of uranium in the earth ceased as soon as the earth separated from the sun, it follows that the earth cannot be older than $3 4 \times 10^9$ years—about twice the age of the oldest known radioactive minerals In addition, if the age of the sun is of the order of magnitude estimated by Jeans, namely, 7×10^{12} years, it is clear that the uranium isotopes which we observe in the earth must have been forming in the sun at a late period of its history, namely, about 4×10^9 years ago If the uranium could only be formed under special conditions in the early history of our sun, the actino uranium on account of its shorter average life would have practically disappeared long ago We may thus conclude I think with some confidence, that the processes of production of elements like uranium were certainly taking place in the sun 4×10^9 years ago and probably still continue to day E RUTHERFORD

The Theory of Electrical Rectification

IT is an experimental fact that certain electrical conductors, when connected in series so as to form a circuit, present a different resistance to currents flowing through them in opposite directions Examples are the electrolytic rectifiers, the crystal rectifiers, and the dry plate rectifiers recently developed In some cases the rectification undoubtedly is due to the circuit itself being modified by the flow of the current Thus, for example, in an electrolytic rectifier a layer of oxide may be formed on one of the electrodes when the current is passing in a given direction, obstructing its further flow, while no such layer appears at the other electrode, made of a different material, when the current is reversed Thermo electric effects may occasionally play a rôle too In crystal rectifiers, however, the rectification must in general be caused directly by the interaction of the crystal lattices with the conduction electrons (W Schottky, *Zeit f Phys*, **14**, 63; 1923) For it appears that they rectify alternating currents of frequency 10^7, and of the order of a microampere only (R Ettenreich, *Phys Zeit*, **21**, 208, 1920), and the amount of substance chemically changed in an electrolytic action during a half period of such an alternating current is altogether too small to be made responsible for the phenomenon, quite apart from the fact that chemical changes would scarcely be capable of taking place with a frequency of 10^7 As Ettenreich (*l c*) remarks himself, the thermoelectric explanation too is invalidated by his experiments The question arises then as to what is the elementary mechanism underlying this kind of rectification

The resistance of a metallic conductor is caused by the transfer of momentum which the conduction electrons have gained under the influence of the applied electric field to the ions of the crystal lattice through collisions or, in the language of wave mechanics, by the scattering of the waves representing the conduction electrons under the action of these ions Rectification signifies here, therefore, a difference in the scattering power of the circuit for electron waves travelling in opposite directions

If in first approximation we regard the ions in the lattices as fixed in space, we are led to study the influence on a plane monochromatic electron wave of a field of force the potential V of which vanishes for $x = \pm\infty$, while in planes parallel to the $y z$ plane it is doubly periodic According to wave mechanics such a wave, representing a stream of electrons of definite velocity parallel to the wave normal, on encountering the potential V is partially reflected and partially transmitted We inquire then if the coefficient of reflection for a given V is the same for incident waves travelling in opposite directions It can easily be proved that even if the potential V is not symmetrical along the x axis, as in the case of a number of conductors in series, there is no difference in the coefficient of reflection It is hence not possible to explain the rectification here considered on the basis of the assumption that the ionic lattices act on the conduction electrons like a field with a given potential V

If now we regard the ions of the lattice no longer as fixed centres of force, we come to investigate if there will be a difference in the scattering action on electron waves travelling in opposite directions, of particles bound to positions of equilibrium by restoring forces not symmetrical for equal and opposite displacements It can be shown by a perturbation method that in general the scattering is indeed different Assymmetrical binding of the ions, which, for some of the substances used in rectifiers actually has been ascertained even for the interior of the crystal by X ray analysis, will come mostly into play near the boundary, and to a still greater degree at the edges and corners of a crystal lattice This may be the explanation why some crystal rectifiers consisting of a metal point in loose contact with the crystal have their rectifying properties diminished or entirely spoiled if the point is pressed tightly against its base, for in this process the sharp corners are flattened out From the viewpoint of the theory here set forth, there seems to exist the possibility of volume rectification in contradistinction to surface rectification for crystals in which, even in the interior of the lattice, the ions are subject to restoring forces not symmetrical for equal and opposite displacements No experimental data appear at present available to show clearly the existence of this effect

The proof of the reciprocity theorem for electron waves mentioned above, as well as a mathematical discussion of the difference in scattering caused by asymmetrically bound particles, will be given elsewhere R DE L KRONIG

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Utrecht, Jan 28

The Extermination of Whales

SIR SIDNEY HARMER, in an important paper (Linnean Society, May 24, 1928), directs attention to the wasteful way whales have been killed in the past and to the danger of exterminating them As regards the Greenland whale, the facts seem to be worse than Sir Sidney states

Scoresby, speaking of its capture in the Greenland Sea, says towards the end of the eighteenth century: "A striking epoch in the history of the fishing arose" " two or three of the captains of the whale-fishing ships " " instead of being contented with two or three large fish and (instead of) considering five or six a great cargo, set the example of doubling or trebling the latter quantity "

The increased activity thus initiated (which doubt-

less meant entering the ice to an increased extent) certainly led to the capture of a very large *number* of whales, but the statistics of the fishing prove that they yielded only a low average of oil and that many of them were of small size

In the Greenland Sea between 1792 and 1822 Scoresby, senior, captured 533 whales and brought home (including some seal oil) 4664 *tuns* of oil, an average (without deducting anything for seal oil) of only 8 7 *tuns* (of 252 gallons, weighing about 17 cwt 1 qr) per whale against the 20 tons or more of the fully grown animals Again, in the *Henrietta*, in the three seasons 1792, 1795, and 1798, he captured 79, which only boiled 457 *tuns*, or an average of only 5 6 *tuns* per whale

The statistics of the Peterhead fleet tell the same tale, in the twelve seasons 1805–1816, the ships of this fleet captured 868 whales, which (possibly including some seal oil) yielded only 7195 *tuns*, or an average of only 8 3 *tuns* per whale

The young whales are less wary and more easily approached than the old, and as they are often found at the edges of large unbroken fields with only confined spaces to rise and breathe in, their capture is usually easy, it was doubtless in favourable circumstances of this sort that in 1814 the *Resolution* caught 44, which averaged only about 5 tons, and that the same year the crew of the *John* captured 13 at a 'fall,' or without stopping to take a rest

This wasteful method of carrying on the fishing soon made itself felt, up to about 1820 it remained productive enough and gave profitable employment to a large number of ships, but after that date it began to fall off, and but for the fact that the whalers had the seals to fall back on and were able to supplement their catches of whales, and for a rise in the price of whale bone, the fishing in this region would have ceased nearly a hundred years ago

The following figures are taken from the record of the Peterhead fleet 1800–9, average number of whales per ship per voyage, 16 8, 1810–19, 11 3, 1820–29, 7 2, 1830–39, 3 5, 1840–49, 2 1, 1850–59 1 7

In the Greenland Sea the Greenland whale was undoubtedly brought to a very low ebb before its pursuit was abandoned, in the 'eighties we seldom saw more than one or two at a time and seldom more than a dozen or two in a voyage In 1890 only six were seen by all the ships, and in 1898 not a single one

The following figures show how this branch of the trade, notwithstanding the high price to which whale bone rose, continued to decline 1860–69 (disregarding a few killed by the Germans before they gave up the trade), 88, 1870–79, 75, 1880–89, 85, 1890–99, 38, 1900–9 (four seasons no ships in pursuit of them), 28

At Davis Strait the sequence of events was similar to that which took place in the Greenland Sea In this inlet the fishing commenced in 1719, and so long as it was confined to the east or Greenland 'side' the whales killed yielded a fairly high amount of oil (14 tons for the four years ending 1817) and must have been mostly of large size, but after the extension of the fishing to the '*west side*' in 1820, consequent on Ross's voyage, the whales killed yielded a much smaller amount and must have been mostly of small size, for example, in the three seasons 1832, 1833, and 1834, the Peterhead ships captured 415, which on an average yielded only 7 *tuns* (equal to about 6 imperial *tons*) apiece, and in 1845 the *Joseph Green* killed 40, which yielded only 185 tons and a negligible amount of 'bone'

This wasteful method of carrying on the fishing again quickly made itself felt, as the following figures taken from the records of the Peterhead fleet show 1820–29, average number of whales per ship per annum, 9 5; 1830–39, 7 4, 1840–49, 6 6, 1850–59, 2 3

The figures for the period 1820–50 would doubtless be higher if the ships (sailing ones) could always have got through Melville Bay and reached the west side and Ponds Bay in time, and after the introduction of 'steam' the figures again show an increase, but it was not long before they again began to decline

In Davis Straits, as at Greenland, the whales were brought to a very low ebb, and it is very doubtful if they will ever recover the ground they have lost, the following figures speak for themselves 1870–74, total number killed, 724, 1875–79, 343, 1880–84, 350, 1885–89, 76, 1890–94, 77, 1895–99, 58, 1900–1904, 68, 1905–1909, 31

In the Greenland Sea the smallest whales were captured north of latitude 79°, at any rate north of 78° (in May and June) and in Davis Straits mostly at the mouths of Lancaster Sound and Ponds Bay (in June and July), and if the whalers had refrained from capturing in these situations, these branches of the whale-fishery would undoubtedly have continued productive, and an interesting and valuable animal saved from almost total extinction Cannot the fin whales be protected in some such way ?

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Retardation of the Ripening of Pears by the Exclusion of Oxygen

IN view of the interest taken by growers and merchants in England and in South Africa in the possibilities of a new process for the handling of quickly ripening pears in sealed tins or in sealed and punctured tins, the following observations on the behaviour of pears in an atmosphere of nitrogen may be of scientific interest and practical importance

As a rule, pears are gathered whilst unripe and hard The yellowing, sweetening, softening, and

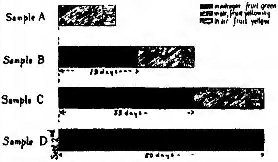

FIG 1 —*Prolonging the storage life of pears* (Souvenir de Congres) by holding them in nitrogen Although normal in appearance when removed from nitrogen after 50 days, sample *D* failed to ripen normally when removed to air

development of juiciness and final mealiness take place in storage In some varieties, such as the well-known Williams' Bon Chrétien or Bartlett, these changes are very rapid, in others, such as the Winter Nelis, they are slow

If oxygen be withheld by sealing up pears in a gas tight container over alkaline pyrogallol (an absorbent of carbon dioxide and oxygen) almost complete inhibition of the various macroscopic changes which are termed 'ripening' is brought about

We have in this way kept in a hard green condition for several months varieties of pears which in air at ordinary room or shed temperatures softened and decayed within a week or two The appearance of the fruit on removal after several months' storage in nitrogen was remarkable, being identical with that

shown by the fruit when placed in the sealed container The pears, moreover, were edible and free from objectionable flavour, nevertheless they proved disappointing because they failed to yellow, ripen, and develop juiciness and the typical pear flavour

The above is the result obtained in the extreme case of prolonged exposure to conditions of oxygen starvation Practical and theoretical interest, however, lies in the fact that the retardation of subsequent ripening in air is a function of the time of exposure, so that by adjusting the time of exposure we can change a quickly ripening fruit into a more slowly ripening one which may attain a quality equal to that of untreated fruit

The original observation of this phenomenon was made by us several years ago Samples of fruit from some of the original experiments, together with the chart herewith presented, were exhibited in the Ministry of Agriculture's Demonstration Tent at the annual fruit show of the Eastern Counties Commercial Fruit Show Association held at Wisbech in the autumn of 1920

An investigation of the effect of the variables—oxygen, carbon dioxide, and temperature—on the changes that occur in fruit during storage has since been carried out, and some of the results obtained have been described in Reports Nos 12 and 30 of the Food Investigation Board The rate of ripening is a function of the concentration of oxygen and of the concentration of carbon dioxide over a considerable range Suitable concentrations of sub normal oxygen and super normal carbon dioxide can be obtained simply by restricting and regulating the ventilation of the stored fruit, and a crude method of doing this is to use a tin container with a small puncture in it

Such a method is merely an extension to fruit in bulk of a mechanism with which each fruit is provided by Nature Ventilation of the interior of individual fruits is restricted by the presence of a relatively impermeable skin with numerous small openings (the lenticels), so that the oxygen concentration in the internal atmosphere of a fruit such as the apple is always less than that in air, whereas the concentration of carbon dioxide is greater

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Regional Isostasy over the Oceans

IMPORTANT evidence that the isostatic compensation over ocean areas is regional, and not local, is furnished by the remarkable series of gravity measurements around the world made by Meinesz in a Dutch submarine, the results of which have just been published by the Geodetic Commission of Holland ("Détermination de la Pesanteur en Mer," Delft, 1928)

The provisional anomalies for 128 stations on the sea are given, reduced by several different methods One of these, the Hayford, is based on the hypothesis of complete local isostatic compensation These results add to the proof I have given that this hypothesis leads to appreciable error, as it is in conflict with known properties of crustal material

Meinesz made gravity determinations over the greatest ocean depths, including the Guam and Philippines Deeps of 8740 metres ($5\frac{1}{2}$ miles) The station over each of these Deeps may be combined with a neighbouring shoal water or port station to form a pair, with greatly different ground elevations There are seven such pairs of stations, which have depth differences of from 3600 to 8740 metres, with horizontal distances of from 23 to 83 miles only

These ocean pairs show the same effect that I first pointed out in 1912 from similar land pairs of stations, when the Hayford anomaly for the valley station is subtracted from that for the high station the predominating difference is distinctly positive, the differences are +0 119, +0 103, +0·043, +0 102, +0 045, −0 031, and +0 064 dyne. The positive difference is the effect of over-compensation of the high station and under-compensation of the low station, resulting from the Hayford hypothesis The average effect for these seven pairs is +0 0016 dyne for each 100 metres difference in elevation, after reducing the water depth to its equivalent in crustal material This fact, and a rough test, show that the results for these stations will be more consistent when a regional reduction is used This confirmation of regional isostasy by ocean observations is important, as these stations near the surface of the sea are more free from various suggested causes of local disturbance than are the corresponding land stations

This work of Meinesz and others shows that there is still a wide field for gravimetric research as to the earth's crust To facilitate such research the reduction methods should be put in order They should have less confusing designations The most used reduction is variously called 'Faye,' 'free air,' or 'elevation only,' but more often is not named at all 'Isostatic,' unqualified, is improperly applied to a method based on an extreme and untenable hypothesis, isostasy is a general theory, there are already a number of isostatic reductions, and there is no reason to restrict this designation to a particular brand of isostasy Some degree of regional isostasy must be taken into account Agreement on a convenient unit designation for 'g' is needed, 'dyne' is objected to, but 'cm /sec ^{2}' is an awkward expression for so important a unit In investigations involving so many possible variants, as do these affecting the earth's crust, the value of differential methods should be recognised, one example is the above method of using pairs of neighbouring stations, and another would be the study of ocean and land conditions by comparison of groups of level area stations nearly in one latitude, thus eliminating uncertainties in the basic formulæ

GEORGE R PUTNAM

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Dec 20,

Pre-Palæolithic Implements

IN NATURE of Feb 16, p 257, after some comments upon my recent paper in *Proceedings of the Prehistoric Society of East Anglia* (vol 5, pt 3) on the further discoveries of Chellean implements derived from the base of the Cromer Forest Bed, it is stated that "it may not be out of place to direct attention in this connexion to some remarks on the subject of tertiary man in *Man* for January"

I may, however, perhaps be permitted to express my disagreement with this conclusion To begin with, though the comments in NATURE appear under the title "Pre Palæolithic implements," the specimens described in my paper mentioned above are definitely of palæolithic age

Secondly, as I have endeavoured to make clear on several occasions, I regard the Cromerian industries as of Early Pleistocene antiquity, and that therefore they can have no relation to any supposed problems as to the former existence of tertiary man

Thirdly, rostro carinate implements had been superseded by the hand-axe in Chellean times, and are, in consequence, almost unknown upon the foreshore sites under discussion, from which it follows that to attempt to involve the fundamentally different speci-

ments from these sites in the still smouldering but much enfeebled controversy as to the human origin of the rostro-carinates is futile

A perusal, on the part of the writer in NATURE, of my papers on the flint implements from the Cromer Forest Bed should have made these various points abundantly clear J REID MOIR

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Dr H J H Fenton

MY friends C T H and W H M have given in NATURE of Feb 16 a most sympathetic account of their late colleague, Dr Fenton Beyond the University of Cambridge, however, there are not a few who would wish to pay tribute to his memory—especially to his greatness as a teacher It was my good fortune to know Fenton almost intimately from an early date We were fellow examiners in natural science at Cambridge and together gave the present master of Pembroke the degree which he has since so well shown to be a proper apprizement it is always interesting to have early judgments verified

Fenton was never a mere teacher of science A man of truly scientific mind, he sought to train his pupils to be scientific, something very different Never a believer in gods, a hater of dogmatism, he was careful to present each problem in its varied aspects, asking his hearers to balance the evidence for and against any particular conclusion—leaving them, having paid their money, to make their own choice, then with reserve He did this with an air of aloofness, in an apparently affected, lackadaisical but actually very deliberate way, which was most arresting, time was given for what he said to soak in, a challenge to consider his argument Fluent lecturers are rarely good teachers I remember my son, as a medical student, being deeply impressed by his teaching—picking him out as the one lecturer worth hearing If there were only a few teachers such as he was, the position of our science would be far higher, it would be a judicious and logical discipline

Fenton's discovery of dihydroxymaleic acid—a true discovery—was one of the most masterly pieces of experimental work ever done, the importance of which has yet to be fully appreciated Having in some way, in early days, fallen foul of authority, outside the Chemical Department he was never held in favour This he bitterly resented His queerness was not a little due to the failure of the powers that were to accord him the sympathetic recognition which he knew was owing to his services and achievements Let us hope that someone will come forward as his biographer and display his method in all necessary detail

HENRY E ARMSTRONG

An Iodine Liberator from Laminariæ

THE evidence which Prof Dillon brings forward in his letter (NATURE, Feb 2, p 161) does not entirely warrant his conclusion that the agent present in an acidulated extract of *Laminaria* fronds which liberates iodine from potassium iodine is an *organic* substance

Inorganic oxidising agents exist, dialysable but relatively heat-labile in presence of organic matter, which might occur in his extract, and would account for his experimental findings One of these, sodium (or potassium) *iodate*, which in pure aqueous solution in quantities containing only 0 1γ iodine, or even less ($\gamma = 10^{-6}$ gm.), will liberate, in presence of slight excess of potassium iodide and dilute sulphuric acid, free iodine in sufficient amount to be detected by shaking the reaction mixture with a drop of chloroform, or by the addition of starch solution In view of the large quantity of iodine in various states of combination in these algæ, and the relative ease with which iodate may be formed, the presence of small quantities of this salt is not altogether unlikely Iodate and iodide could co exist in the neutral or faintly acid environment of the algal tissues, but would react when the tissue or tissue extract was rendered distinctly acid

If results obtained using mammalian tissue extracts are any guide to the behaviour of plant extracts, there is little doubt that a very minute addition of an iodate to the *Laminaria* extract would reveal itself as a potent 'iodine liberator,' would be dialysable, and would have the same order of heat-lability as was found for this agent by Prof Dillon The original extract would probably be found to be rather less active than the outer liquid after dialysis, since the former contains organic substances of high molecular weight which would be expected to combine readily with traces of free iodine, and thus inhibit to a greater or lesser degree the phenomenon of iodine liberation It would appear that iodate, at least, should be shown to be absent before the organic nature of the iodine liberating agent can be satisfactorily maintained

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Unified Field Theory of Electricity and Gravitation

MAY we be permitted to direct attention to a certain aspect of Einstein's three recent papers (*Berliner Berichte*, pp 217, 224, 1928, Feb 1929) on distant parallelism which came to light in a discussion with Prof D J Struik? The avowed aim of these papers is to develop an improved unified field theory of electricity and gravitation A much more pressing need of general relativity theory is a harmonisation with quantum theory, particularly with Dirac's theory of the spinning electron On the basis of Levi Civitá's parallelism the task seems hopeless, inasmuch as we have no adequate means of comparing spins at different points On the other hand, the notion of a parallelism valid for the whole of space and of Einstein's n uples enables us to carry over the Dirac theory into general relativity almost without alteration All that we need do is to interpret Dirac's p_0, p_1, p_2, p_3 not as differentiation with respect to four variables x, y, z, t defined throughout space time, but as differentiation along the lines of the quadruple (Einstein's '4 Bein') That is, the quadruples need not be integrable so as to furnish us with a co ordinate system throughout space, for such a co-ordinate system is absolutely inessential in the proof of the invariance of Dirac's equations under a Lorentz transformation

In other words, the quantities ${}^s h_\lambda$ of Einstein seem to have one foot in the macro mechanical world formally described by Einstein's gravitational potentials and characterised by the index λ, and the other foot in a Minkowskian world of micro mechanics characterised by the index s That the micro mechanical world of the electron is Minkowskian is shown by the theory of Dirac, in which the electron spin appears as a consequence of the fact that the world of the electron is not Euclidean, but Minkowskian This seems to us the most important aspect of Einstein's recent work, and by far the most hopeful portent for a unification of the divergent theories of quanta and gravitational relativity

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Cambridge, Massachusetts, U S A,
Feb 7

The Electronic Charge e

PROF A S EDDINGTON has recently (*Proc Roy Soc*, A, **122**, 358, Jan 1929) deduced a theoretical value of 136 for the well known ratio $hc/2\pi e^2$ The reciprocal of this ratio is usually denoted 'the fine structure constant α' Without presuming in any way to judge the theory on which this value is derived, I should like to make a few remarks as to the numerical result The value of the velocity of light c is known with great accuracy ($c = 2\ 99796 \pm 0\ 00004$) On the other hand, the value of the Planck constant h depends primarily upon the value of the electronic charge e, and the probable error in h is almost entirely due to the probable error in e Every method for evaluating h involves e to a positive power varying from unity to two The average power depends upon the adopted relative weighting of the different methods These facts regarding the connexion of e and h I discussed some years ago (*Phys Rev*, **14**, 361, 1919)

I am at the present moment just finishing a critical investigation of the probable values of the general constants of physical science and a detailed account of this work will be published shortly At the present time my adopted value of h depends, in the mean, on the 1 236 power of e Hence the *ratio* h/e^2 varies as $1/e^{0\ 764}$ The change in this ratio demanded by Eddington's theory is approximately 1 per cent downward (0 94 per cent, using my own adopted values of e, h, and c) Accordingly, such a change requires an increase in e of approximately one and one quarter per cent, and a resulting increase in h of about one and one half per cent, in contrast to a one half per cent increase in e (and *no change* in h) assumed by Eddington as required In my opinion the commonly accepted value of e has a probable error of roughly 0 1 per cent, and it is accordingly extremely improbable that the true error is more than twelve times as great

RAYMOND T BIRGE

University of California, Feb 2

The Boundary of the Solar Chromosphere

THE question of the sudden ending of the chromosphere or its gradual fading away in accordance with Prof Milne's theoretical views may not yet be settled finally by observation Mr R W Gurney is, however, under a misapprehension (NATURE, Feb 16, p 240) in thinking that the bright K line studied by Mr P A Taylor and Mr McCrea up to a height of nearly 100,000 km above the sun's limb was thought to be an ordinary chromospheric line The tangential slit happened to fall across a high prominence and the measures refer to the portions of the slit lying on the prominence, which gave a regular fading away with height, one or two obvious brightenings had to be ignored, where structure in the prominence complicated the issue These points were easily recognised in the picture of the prominence shown in the second flash spectrum which was obtained with an objective prism

The difficulty of the scattering of light in our atmosphere is not easy to meet, but evidence from our other plates, for example, the objective prism spectra, does not point to any serious trouble in our case We had the good fortune to observe the sun in a perfectly clear hole in a somewhat cloudy sky Messrs Miller and Marriott, half a mile away, observed through thin haze The heights of the chromospheric lines proper, which we published, were taken from the arcs given by the objective prism spectrograms of the flash, and these would not be seriously affected by light scattering Incidentally, it may be added, they are not inconsistent with Mr Gurney's views

F J M STRATTON
C R DAVIDSON

Feb 18

An Isotope of Oxygen, Mass 18

THE weak doublets of the atmospheric absorption bands of oxygen have been found to originate from a molecule consisting of an oxygen atom of mass 18 combined with one of mass 16 The interpretation recently published by Mulliken (*Phys Rev*, **32**, 880, 1928) for the strong bands holds in every detail for the weak band The isotopic rotation–zero point vibration doublets have been calculated by means of the equations of Loomis (*Bull Nat Res Council*, **2**, chap v, 1926) and the atmospheric absorption data of Dieke and Babcock (*Proc N A S*, **13**, 670, 1927) The vibrational frequency used for the lower state is that calculated by Birge (*Bull Nat Res Council*, **2**, 232, 1927) from the available data From the above, the formulæ for the separation of the isotopic doublets in the four P and four R branches is as follows

$$\Delta\nu_P = 2\ 12 + 0\ 0556[B''m^2 - \beta''m^4 - B'(m-1)^2 + \beta'(m-1)^4]$$

$$\Delta\nu_R = 2\ 12 + 0\ 0556[B''m^2 - \beta''m^4 - B'(m+1)^2 + \beta'(m+1)^4]$$

$$m = \frac{3}{2}, \frac{7}{2}, \frac{11}{2}, \text{ etc}$$

The constants as given by Dieke and Babcock are

$$B'' = 1\ 438 \qquad \beta'' = 6\ 31 \times 10^{-6}$$
$$B' = 1\ 390 \qquad \beta' = 5\ 75 \times 10^{-6}$$

The average deviation of observed minus calculated separations is $-0\ 05$ cm^{-1} The maximum deviation is $-0\ 13$ cm^{-1} This is well within the limit of accuracy of the data No other isotope of oxygen combined with an atom of mass 16 will satisfy the data The data show that the normal state of the oxygen molecule has one half unit of vibration in agreement with the wave mechanics theory

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Intercombinations in the Arc Spectrum of Carbon

PROF A FOWLER and E W H Selwyn have recently classified the lines of the arc spectrum of carbon, and identified triplet as well as singlet terms, but no intercombinations have apparently been obtained Recently I took a heavy arc spectrum of Acheson graphite in the region λ2000, and obtained a number of lines, some new, and others recorded by previous observers like McLennan, Hutchinson, and others I was able to identify the following intercombination lines

	Classification.	Transition
51313	$^1\bar{D}_2 - {}^3P_1$	$(2L_2 \longleftarrow L_1M_1)$
51356	$^1D_2 - {}^3P_2$	(,,)
39862	$^1\bar{S}_0 - {}^3P_1$	(,,)

This enables us to calculate the exact differences between the fundamental levels $^3P_{012}$ and $^1D_2$, $^1S_0$ of $2L_2$ We get $^3P_1 - {}^1\bar{S}_0 = 20474$, while according to Fowler and Selwyn it is 21142 Taking Fowler's $^1D_2$ value as the more correct, the values of fundamental ^3P terms have to be decreased by 667 cm^{-1} We have also lines conforming to the inner-transitions $(L_2L_3 \longleftarrow L_1 3L_2)$, from the new lines I have also obtained identification of some of the $(2L_1L_2M_1 \longleftarrow L_1 2L_2M_1)$ transition lines

The frequency difference $^3P_1 - {}^1S_0 = 20474$ corresponds to the wave length λ4884 2, and I could get no such line in the coronal spectrum

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Aspects of Fossil Botany[1]

By Dr D. H SCOTT, F R S

I FERNS AND SEED FERNS

THE fact that many of the well known fern like fossils of the Carboniferous formation were not ferns at all, but true seed-bearing plants, has long been familiar to students of palæobotany It is a quarter of a century since the recognition of the seeds of *Lyginopteris oldhamia* by Prof F W Oliver first led to the institution of the class Pteridospermeæ, or, in popular language, seed ferns Yet, after this lapse of time, and in spite of all the attention given to the subject, much still remains obscure We are still ignorant of the relation between true ferns and seed ferns, either as regards their respective importance in Carboniferous times, or the degree of affinity between them

The early discoveries, in *Lyginopteris*, *Neuropteris*, *Aneimites*, and *Dicksonites*, cast doubt on such extensive groups of supposed ferns, that the impression was soon created that a majority of the Carboniferous ' ferns ' were, in reality, seed plants At the present time even the great tree-ferns, the so-called Marattiaceæ of the Coal measures, are called in question Were they ferns or Pteridosperms ?

Since the original discoveries of 1903–5, a number of additions have been made to our knowledge of seed-bearing plants of fern-like habit Cases of direct continuity of seed with frond have been demonstrated in a further species of *Neuropteris*, in a *Sphenopteridium* and in a *Sphenopteris*, the two latter of Lower Carboniferous age Prof Halle, in his important investigation of the fossil flora of China, has already discovered five new cases of the kind, in the Permo Carboniferous beds of the Province of Shansi, in northern China One of his discoveries must be specially considered, for it has a direct bearing on the position of the supposed Marattiaceæ of the period

The plant is *Pecopteris Wongii* (named after a Chinese colleague) There seems to be no doubt that one seed at least is attached to the rachis of the frond, while others are so grouped as to suggest a connexion The seed is an ovoid body about 7 mm in length The case is a critical one, for the new species is almost identical with the well known *P Miltoni*, which has the fructification of *Asterotheca* and is therefore referred to Marattiaceous ferns If it were positively known that *P Wongii* bore the sporangia of *Asterotheca* as its male organs, the new species would afford the strongest evidence in favour of the transference of the Carboniferous ' Marattiaceæ ' to the Pteridosperms

In *Nystroemia*, a new genus, both sporangia and seeds were found, on distinct specimens, almost certainly belonging to the same plant This plant thus appears to be one of the rare and fortunate instances in which both sexes are known in the same Pteridosperm

The most important, however, of the new Pteridosperms is undoubtedly the American genus *Eospermatopteris*, described by Miss Goldring It is of Upper Devonian age, and is thus the oldest known seed bearing plant To avoid repetition, *Eospermatopteris* will be considered in the following article, devoted to early floras

The male or pollen-bearing organs of the Pteridosperms are of special importance in the present survey, for it is chiefly on them that the comparison with the contemporary tree ferns, the so called Marattiaceæ, depends

The original discovery, by Kidston, of the *Crossotheca* fructification of *Lyginopteris* is well known The fertile pinnules are oval leaflets bearing pendulous sporangia or pollen sacs on their lower surface The peculiar feature is the bilocular structure of each pollen sac, a point difficult to demonstrate in the imperfectly preserved material Indirect confirmation is, however, afforded by clearly bilocular sporangia observed by Prof Oliver in petrified specimens of other fructifications Some doubt has been cast on the identification of the frond, Zeiller, however, accepted it as the foliage of *Lyginopteris* The genus *Telangium*, founded by Dr Margaret Benson, differs from *Crossotheca* in the sporangia standing erect on the end of the stalk, instead of being pendulous Dr Benson thought that her species, *T Scotti*, was the male fructification of *Lyginopteris oldhamia* It may have belonged to some allied plant, but the sporangia are not bilocular Various other fructifications, preserved in the form of impressions, have been referred to *Telangium* and regarded as the male organs of Pteridosperms

Our knowledge of the supposed male fructifications of seed ferns is often unsatisfactory, owing to the obscurity of fossils preserved as structureless impressions Kidston's case of *Neuropteris Carpenteri* is one of the best, for here the fertile pinnules are on the same frond with the sterile leaflets, differing somewhat from them in shape The densely packed sporangia contain a quantity of spores—no doubt the pollen grains In *Potoniea* the large orbicular discs have been shown to bear sporangia This genus probably represents the male fructifications of species of *Neuropteris*

It may be said that the polliniferous organs of the Pteridosperms, where known, are almost constantly borne on specially modified pinnules or on a naked rachis The only case in which they have been found, as it appears, on the unaltered frond, is that of *Dicksonites Pluckeneti*, to which we shall return

It has hitherto been generally assumed that there existed, in Carboniferous and Permian times, a considerable body of true ferns, side by side with the Pteridosperms, or seed-plants of fern like habit The true ferns were regarded as including three groups, the Primofilices, the great tree ferns of the

[1] Based upon a short course of lectures delivered at University College, London, last autumn.

Upper Carboniferous, and a few others, such as the Permian Osmundaceæ

The Primofilices are undisputed, and so are the Osmundaceæ of the late Palæozoic The great problem is that of the tree ferns commonly referred to the Marattiaceæ These plants had tall stems, reaching at least 60 feet in height, clothed with a felt of descending roots The highly compound fronds were of the *Pecopteris* type, resembling species of *Cyathea* among living ferns The stems, known as *Caulopteris* or *Megaphyton* by their external features, as *Psaronius* when the structure is preserved, bore the large and conspicuous leaf bases, and had a completely fern like anatomy, usually with many concentric steles There is a general, though not an exact, anatomical resemblance to the recent Marattiaceæ, and this is also shown in the polyarch roots

The fructifications, in most cases borne on the underside of the fronds, are also Marattiaceous in type, the sporangia of each group being united together in various degrees, to form synangia In most of the genera the sporangia are grouped about a centre, the synangium thus being more or less circular, as in the recent *Kaulfussia* In *Ptychocarpus* they are completely united, and so also in a genus *Cyathotrachus*, discovered by Prof Watson In *Asterotheca*, of which many species are known, the sporangia are only slightly connected at the base, and the synangia are seated directly on the frond In *Scolecopteris* the arrangement differs in the fact that the synangium (of four or five sporangia) is borne on a definite pedicel In *Acitheca*, often included under *Scolecopteris*, a pedicel is present, but the sporangia are not seated on it but merely fixed around it

I have recently observed a new species of *Scolecopteris*, and propose to name it *S Oliveri*, after Prof Oliver, who brought the material in which the specimens occurred from Autun The sporangia are elongated, regularly four in each synangium, the most characteristic feature of the new species is that each fertile pinnule is immediately subtended by an apparent sterile pinnule, exactly fitting on to its lower side It is probable that the two bodies are parts of one and the same pinnule, strongly incurved on itself

So far, everything in these plants seems fern like and much suggests the Marattiaceæ Yet the highest authority, Dr Kidston, in his latest work, expressed grave doubts as to the nature of this group His opinion is stated in his great series of memoirs on the "Fossil Plants of the Carboniferous Rocks of Great Britain," which were in course of publication at the time of his death In his first memoir, Dr Kidston was still inclined to accept the current view, for he then thought it tolerably certain that the typical Pecopterids, with exannulate sporangia united into synangia, were ferns (Part 1, p 17, 1923) In a later memoir, issued the same year, his tone is more doubtful, but he still allowed that *Asterotheca* and probably a few other Carboniferous plants that bear exannulate sporangia "may be Marattiaceous" (Part 4, p 277) In the next memoir Dr Kidston left the systematic position of *Asterotheca* an open question, but added "The generic differences which separate *Scolecopteris* from *Asterotheca* are those of degree rather than of structure The former genus I believe to be more probably a Pteridosperm than a fern" (Part 5, p 483, 1924) Thus one important genus was already given up, and it was becoming clear that its companion must follow Lastly, in the final memoir so far issued, Dr Kidston stated that the affinities of *Acitheca* seemed to him to be Pteridospermous, and if so, that he could not see on what grounds *Asterotheca* and *Scolecopteris* could be excluded from the Pteridosperms "It would therefore appear that the evidence in support of the occurrence of Marattiaceous Ferns in Carboniferous times rests on supposition, rather than on satisfactory proof" (Part 6, p 538)[2]

We thus have to face the question whether true ferns (apart from the special group of the Primofilices) existed in the Carboniferous period We can come to no conclusion, but may briefly sum up the arguments on either side In favour of fern affinities of the plants in question we have

(1) The habit (unimportant, for undoubted Pteridosperms are just as fern like), (2) the fructifications, almost the same as in living Marattiaceæ, and, as in them, usually borne on the ordinary frond, (3) the anatomy of stem and root, both altogether like that of ferns, and especially of Marattiaceæ

Thus, in every respect, these Carboniferous plants appear like ferns But the following are the arguments on the Pteridosperm side

(1) The resemblance of the synangia of these plants to those of *Telangium* this appears to be the point which chiefly influenced Kidston, *Telangium* being regarded as the male fructification of certain seed ferns, (2) *Crossotheca*, known in one case to have been the male fructification of a Pteridosperm, also occurs on Pecopterid fronds, (3) *Dicksonites* (= *Pecopteris Pluckeneti*), once universally accepted as a fern, probably Marattiaceous, is now known to have been a seed bearing plant, (4) the instance of *Pecopteris Wongii*, already discussed, may prove to be conclusive, but the case is not yet closed

Dicksonites is at present the only plant of the so called Marattiaceous group which has been definitely proved to be a Pteridosperm It is therefore of critical importance The pollen bearing organs are somewhat obscure They appear to have been borne on the ordinary leaflets and to have consisted of tufts of sporangia, which Kidston compared to the synangia of *Telangium* It would be of the utmost value to learn the anatomy of *Dicksonites* to compare with that of *Psaronius*, the type of stem referred to the 'Marattiaceæ' In the absence of such knowledge, a comparison of the cuticular structure might throw light on the question If *Dicksonites* showed complete agreement with the remaining "Marattiaceæ," we could scarcely doubt that all alike were Pteridosperms This, however, is not yet proved

In the meantime, an anatomist must continue

[2] Parts 5 and 6 were issued posthumously

to be influenced by the old anatomical evidence from the completely fern-like structure of the *Psaronius* stems and roots. If *Psaronius* belonged to seed plants, comparative anatomy would be discredited. Yet it has proved its value, for it was anatomical data which first put us on the track of the Pteridosperms, before the seeds were discovered.

The question of the evolutionary relations of the Pteridosperms, whether they were "ferns which had become Spermophytes" or an independent line of descent, cannot be settled until we know whether the tree ferns of the Carboniferous were ferns indeed or seed plants simulating them. A seed bearing *Psaronius* would go far to resuscitate the former hypothesis, which of late years has seemed the less probable of the two. No such case, however, is as yet demonstrated. The whole question is in urgent need of further investigation.

Geometrical Art in South-east Europe and Western Asia

By Prof JOHN L MYRES

BETWEEN the vivid naturalism of Minoan art, the mature style of Crete and the South Ægean in the later Bronze Age, and the serene idealism of Hellenic art, in the great centuries from the sixth to the third, intervenes a style profoundly contrasted with both, popularly known as the Geometric Style of the Early Iron Age. It inherited something from Minoan art, and contributed more than appears at first sight to Hellenic, but in its maturity it was the negation of all that either Minoan or Hellenic craftsmen aspired to express. Such a group of facts, or sequence of events, presents a problem as fully worthy of scientific treatment as any crisis in geology or natural history: the problem, namely, of the apparitions and disappearances of geometrical art in the lands around the Greek archipelago. For the geometrical art of the Early Iron Age was not the only such occurrence, and its significance is best appreciated by comparison with other geometrical styles.

What we call style is approximation to a standard of achievement, and perfection of style is beauty in art. Geometrical styles come into being in various ways. In primitive Crete, as in other parts of the Mediterranean, vessels of clay were decorated with ornaments which were linear because incised, and rectilinear because they imitated basketry. Such skeuomorphic ornament is not 'geometrical' so long as its imitative intent is obvious; it becomes so as this intent is superseded by appreciation of the linear designs as pure forms and spatial constructions. Before this stage was reached in Early Minoan art, these linear designs were superseded by more or less naturalistic representations of plants and animals, scarcely restricted at all except by the surface of the decorated object.

Similarly, the painted pottery of Thessaly, probably derivative from a widespread Ukrainian culture between Danube and Dnieper, is decorated with lines and bands the prototypes of which—textiles or leatherwork—are uncertain, but the application of which, with utter disregard of the forms of the vessels, is the antithesis of early Ægean 'skeuomorphs'. This primitive style also perished early (with one possible exception) in conflict with the paintless 'gray ware' of Orchomenus, and the almost paintless 'smear-wares' (*Urfirniss*) of the Greek mainland.

[1] Summary of a discourse at the Royal Institution on Friday Feb 1

East of the Ægean, in the heart of Asia Minor, another painted linear style, still imperfectly known, influenced Syria and Cyprus late in the Bronze Age. It may be connected either with the Ukrainian culture or with that of Susa and other sites in the Persian hills and early Babylonia. It does not, however, seem to have affected the coast cultures of the Ægean until the Early Iron Age, and even then but slightly.

After great naturalistic achievements, Minoan ornament declined into mechanical and conventional abbreviations, and broke up into numerous local schools, during the troubled centuries from 1400 B C to 1100 B C or later, and it is as the sequel to this artistic collapse that the Greek geometrical style comes into being. It has been commonly supposed that the new style was introduced into Greek lands by 'northern invaders' from beyond the Danube, or at all events from Danubian countries. But recent discoveries, especially in Macedonia, have shown that, though an invasion occurred about 1100 B C, its range was restricted, its effects were transitory, and the culture it introduced temporarily had no geometrical elements, other than a fondness for compass drawn concentric circles, which had a fairly wide vogue in the mature geometrical repertory of the Ægean, and a far more general popularity in the contemporary art of Cyprus, where there is some reason to suppose that it arrived overland through Asia Minor from the same south east European source. A second suggested source for the geometrical style of the Ægean is in certain scattered and belated survivals akin to the primitive Thessalian decoration, which have been detected in north western Greece; and as the 'Dorian' invaders of peninsular Greece were traditionally derived from this region, these may represent the decorative style which they had before they came south.

It is difficult, however, to reconcile this explanation either with the sequence of styles in stratified deposits at Sparta, the most purely Dorian state in historic Greece, or with the geographical distribution of more or less geometrical styles in the South Ægean, or (most significant of all) with the very early and emphatic outbreak of geometrical art in Attica and its neighbourhood, which traditionally had been the refuge and rallying ground of non-Dorian and pre-Dorian elements from all parts of the invaded area. That the colonies propagated

overseas by these 'Ionian' refugees in conjunction with inhabitants of Attica itself did not share in that geometrical outbreak, is explained if it occurred after their founders had left Attica, and this is in accord with the contrast between Ionian and Attic types of safety pin, and other elements of culture, and the similarities between Attic safety-pins and those of other districts where geometrical styles were established more or less effectively. Provisionally, therefore, the geometrical style may be regarded as an indigenous and local creation of that area of east central Greece where the disturbance and intermixture of older elements in the population seems to have been most intense, and as the artistic expression of the view of life enforced by the stresses of that crisis.

Characteristic of all geometrical art is the abstract quality of its ornaments: they represent no longer, nor even symbolise, any natural object, but have value through their mere forms or the relation which these forms bear to other forms which comprise them. Frequently an ornament and its background counterchange their functions, and secondary patterns emerge, such as the 'key fret' and 'wave-coil,' wherein it cannot be said that there is neither design nor background, but only a positive and a negative element—for example, a black and a white—the combination of which *is* the pattern. In this aspect the Greek geometrical style was not so much a tradition as an invention, the first self-conscious, rationalist style in the history of art. The mere surface of the object, at the frontier between being and not being, *plenum* and void—the form of the object, in complete abstraction from its substance—becomes itself the subject of artistic treatment, anticipating, and perhaps preparing the way for, the philosophical treatment of the same antithesis between form and substance.

A second characteristic is the rhythmical quality of the means employed to distinguish part from whole—the 'many' from the 'one' which they constitute—and attention is directed to the relation between the geometrical art of early Greek craftsmen—including the temple architects—and the metrical inventions of epic and lyric poetry, the only other aspects of the higher life of that age which have been preserved.

Thirdly, the geometrical experiments in composition and artistic structure in two dimensions (whereas the frieze compositions of the Near East and Asiatic Greece, however elaborate, were essentially in linear series) initiates the progress of Attic and Argive schools of design, of architecture, and eventually of sculpture towards the ideals so nearly attained in the sixth and fifth century; to types of literary compositions best illustrated by Attic tragedians and the fifth century historians; and to remarkable experiments in political reconstruction of certain Greek city states, and philosophical analysis of the structure of society and of Nature itself.

An Epic of Fastness

MR JAMES MORTON is an artist, an enthusiast, and a man of imagination, and yet he has chosen to be a textile manufacturer. With such a combination of qualities, there is little wonder that within scarcely more than two decades he has been responsible for an amazing change in the standard of colour fastness as applied to woven fabrics. More than to any other man do we owe it to him that to-day the colours of our fabrics are as sound and as permanent as the fibres of which they are made. The story of this development and that of the necessary dyes is unfolded in simple and almost poetic language in a paper read recently before the Royal Society of Arts[1]; it is one which should be read by every student of the present generation as worthy of ranking with similar stories of the great achievements of inventive industry in the past.

It was in 1902 that Mr Morton, whose firm were makers of high-class furnishing fabrics, was impressed by the fugitive nature of the colours used, and in consequence was led to make exhaustive fading tests on coloured textiles from every source. The uniformly adverse result of these was staggering. It led Morton to institute a constructive campaign which has definitely left a permanent impression on the textile trade of the world. The scheme was to arrive at a range of colours, however small, from which fabrics could be prepared and guaranteed against fading from sunlight or ordinary washing. These, under the descriptive name of 'Sundour' fabrics, were first distributed by Messrs Liberty in 1904. The early palette had a modest range of colours; it was greatly helped by the discovery in Germany of the first of the indanthrene vat colours about this time, whilst, in turn, the scope for these vat dyes was greatly increased by the market which the 'Sundour' fabrics had helped to create for them.

By 1914 the fadeless fabric business was firmly established with a world wide reputation, when on the outbreak of War the manufacturers found themselves suddenly deprived of the supply of German dyes. How Morton first visited other dye-making concerns to learn their intentions in regard to the vat colours, and how he eventually set to work to make indanthrene blue and yellow for himself, must be read in the original paper. Such dauntless energy as he displayed was bound to succeed, particularly when coupled with a full and proper appreciation of scientific research. Next followed the manufacture of Solway Blue—the fastest of the acid wool colours—and then in 1919 Morton returned from having established his dye processes in America with the British rights of the air oxidation process for the manufacture of phthalic anhydride from naphthalene. He tells how his chemists did not at first value this, but that during the slump in 1920 and 1921, following the Sankey judgment which so nearly destroyed the infant dye

[1] History of the Development of Fast Dyeing and Dyes. A paper read before the Royal Society of Arts on Wednesday, Feb. 20.

industry, time was available to study its properties more fully As a result the conversion of the anhydride into benzoyl benzoic acid and the transference of this into anthraquinone intermediates was discovered and the way was open to make these derivatives purer and cheaper than before and, indeed, to effect a revolution in the making of vat dyes The greatest of all new discoveries arising out of this has been that of Caledon Jade Green, which is the only pure green of the anthraquinone vats and is further the fastest all round colour of the whole vat series

Doubly interesting to us now is the palette of the fast colours, for every one of them is full of the intensest new meaning Using Mr Morton's own words, ' it tells of long arduous research, of high pressures and high temperatures, things attempted and done, it tells also of things yet to do that are full of hope and adventure which, after all, is real life "

We have seen in this brief outline how the desire to make the colours worthy of the designs they interpret and of the threads on which they are dyed, has led to the entry of a man, himself not a chemist, into the difficult field of making, under the handicap of war conditions, not only known dyes of great complexity, but ultimately of leading the world in the production of new dyes of greater fastness than any yet known A singleness of purpose has characterised his effort throughout, thought of material gain has been remote, though we believe Mr Morton has earned the greatest of all rewards, that of satisfaction

Truly a worth while story ! E F A

Obituary

SIR HERCULES READ

BY the death of Sir Hercules Read, which took place suddenly at Rapallo on Feb 11, the world of archæology loses one of its most notable personalities Possessed of an extraordinarily wide range of knowledge, he was recognised as a foremost authority in ethnography, in archæology, especially prehistoric archæology, and in fine art His striking appearance and his charm, especially in presiding at a meeting or in addressing an audience, won him a wide circle of admirers His qualities of character secured him many firm friends

Charles Hercules Read was born on July 6, 1857, and was therefore in his seventy second year Becoming closely associated with Sir Augustus W Franks at an early age, he joined the staff of the Department of Antiquities of the British Museum in 1880 Franks was then keeper of that Department, and on his retirement in 1896, Read succeeded him, becoming his residuary legatee on his death in the following year, and contributing his biography to the ' Dictionary of National Biography

Franks had contributed generously from his private resources to the national collections They were no less indebted to Read, though his personal benefactions were on a smaller scale He had the gift of informing with his own enthusiasm the group of wealthy men with whom he was closely in contact, and who benefited by his wide knowledge and taste in forming their own collections It was through him that the little coterie known as Friends of the British Museum " was formed, ultimately growing into the National Arts Collection Fund Through this group many priceless objects were acquired for the national collections which otherwise would have gone to America Among major acquisitions through his influence were the Waddesdon Bequest (collection of Baron Rothschild) in 1898, the Greenwell Collection of Bronze Age antiquities purchased by J Pierpont Morgan in 1909, the bequest of painted enamels of the Rev A H J Barwell in 1913, and the plaquettes given by Mr T Whitcombe Greene in 1915 If Read's own gifts to his Department were less conspicuous for their pecuniary value they were distinguished by the taste and judgment with which they were selected, especially where objects of Eastern art were concerned These same qualities were exhibited in the formation of his own private collections, and justified the prices realised when they were dispersed a few years ago

Read's activities were not confined to the Museum He was secretary of the Society of Antiquities from 1892 until 1908, and twice president of the Society, first from 1908 until 1914, and then from 1919 until 1924 In this capacity he was *ex officio* a Trustee of the British Museum, an office which might have entailed some difficulty had it not been for his correct and tactful attitude He was president of the Anthropological Section of the British Association when it met at Dover in 1899, his address putting forward a suggestion for the foundation of an Imperial bureau for anthropology, which was perhaps one of his most momentous public pronouncements He was also president of the Royal Anthropological Institute from 1899 until 1901, and again during the War from 1917 until 1919 He was president of the India Society He retired from the British Museum in 1921, when a dinner was held in his honour, at which a volume of essays by his friends was presented to him It was illustrated by his portrait from a drawing by Seymour Lucas, R A, and 55 plates showing the most important and beautiful objects of art and antiquity acquired by his Department during his keepership

Neither Read's inclinations nor his qualities led him in the direction of the writing of books He was more at home in the delicate delineation of the distinctive qualities of objects of art or the discrimination in subtle lines of argument as to evidence of provenance which appeal to experts Hence his literary contributions to knowledge appear in journals such as *Archæologia* He was also, however, the author or part author of the guides to the archæological collections of the Museum, the early editions of which appeared directly under his inspiration As one of the most active members of the Burlington Fine Arts Club, he took a large

part in organising the well known exhibitions held by that body

Read received the honour of knighthood in 1912 He was an LL D of St Andrews was elected to the British Academy in 1913 and had received honours from learned societies in nearly every country in Europe as well as the United States He was buried at Rapallo

Mr T H Blakesley

Mr Thomas H Blakesley died on Feb 13 at eighty one years of age To the older generation of physicists and electrical engineers he was well known Much of his work has formed the foundations of great practical and theoretical developments which the younger generation accept with but little if any thought of the pioneers who initiated researches the results of which are affecting the everyday life of almost every nation

Blakesley was the son of the Very Rev J W Blakesley Dean of Lincoln and was educated at Charterhouse and Kings College Cambridge where he graduated as a wrangler in 1869 He first went to Ceylon as an irrigation engineer and then in 1885 he was appointed instructor in physics and mathematics at the Royal Naval College Greenwich In that year Blakesley published his classical work entitled Papers on Alternating Currents of Electricity In this treatise he gives many fundamental theorems In particular he describes how to measure alternating current power by means of his split dynamometer He describes fully how phase difference can be determined and gives for the first time many of those geometrical methods of discussing alternating current problems which are now in everyday use all over the world He made valuable contributions also to the mathematical theory of the transmission of electric power by cables and to long distance telephone working In this connexion he recognised the importance of the hyperbolic functions and computed tables of their numerical values The value of this work was appreciated by experts at the time and translations of it were published in Germany France and Russia

Blakesley was also greatly interested in the reform of the teaching of geometrical optics and used to point out to his friends with great animation the absurdity of some of the definitions of focal lengths etc then in vogue at Cambridge His book on Geometrical Optics appeared in 1903 The principles however of his proposed reforms in optics he gave in a paper to the Physical Society of London in 1897 His paper to the same Society in 1907 on Logarithmic Lazy tongs and Lattice works was of a type which would have been much more appreciated by mathematicians of an earlier generation who liked mathematical recreations His synthetic spectroscope was a colour mixer of a refined type superimposing three homogeneous portions of the spectrum in one picture An instrument of this type was presented to Finsbury Technical College by the Mercers Company of which Blakesley was master in 1902 and 1903

Blakesley did good work as honorary secretary of the Physical Society of London for several years For much of its success and present prosperity the Society is largely indebted to him He did a great deal to encourage the friendly co operation of academic lecturers with research physicists employed in industry which is greatly to their common benefit He will be sadly missed by his friends

Mr Abel Chapman

Since his first work Bird Life of the Borders appeared in 1889 and by its vigour direct and humorous description and evidence of close observation gained the ear of the public Mr Chapman published many accounts of his travels all equally robust and all equally popular He was a sportsman naturalist of the best type as keen to note the ways of his quarry as to secure a trophy and never likely to be led astray by the theories of professional scientific workers whom in a general way he despised His own theories upon such subjects as the migration of birds and protective coloration he defended with abundant confidence and even obstinacy but they suffered from a lack of knowledge of the investigations of other workers in the same field

Mr Chapman s home at Houxty in Northumberland set in the heart of the Border country afforded him fine opportunities of bird watching and his penultimate work The Borders and Beyond (1924) like his earliest dealt mainly with the natural history problems of his immediate surroundings But he followed Nature far afield and his hunting expeditions in Spain Norway East Africa and the Sudan produced a series of interesting books full of acute observations Wild Spain (1893) and Unexplored Spain (1910) Wild Norway (1897) On Safari in British East Africa (1908) and Savage Sudan (1921) In 1896 with Mr W J Buck he published The Art of Wildfowling Only last year his final work appeared Retrospect an autobiographical survey written with the old combativeness and reviewing the more interesting observations of his fifty four hunting trips and home experiences

Mr Chapman was born in 1851 and educated at Rugby He died at Houxty on Jan 23 at the ripe age of seventy seven years

We regret to announce the following deaths

Surgeon Capt E I Atkinson D S O parasitologist to Scott s last Antarctic expedition (1910) on Feb 20 aged forty six years

Dr Harrison G Dyar custodian of Lepidoptera in the United States National Museum a leading authority on American mosquitoes on Jan 22 aged sixty two years

Mrs Arabella B Fisher (*née* Buckley) secretary for eleven years to Sir Charles Lyell the geologist and author of several popular works on general science on Feb 9 aged eighty-eight years

Sir George Fordham author of numerous papers on archæology natural history and other subjects and of volumes on the history of maps and road making on Feb 20 aged seventy four years

Commdr Giovanni Roncagli honorary secretary general to the Royal Geographical Society of Italy, on Feb 1 aged seventy two years

News and Views.

THE Council of the Royal Society, at its meeting on Feb 21, recommended for election into the Society the following fifteen candidates Arthur John Allmand, professor of physical and inorganic chemistry, King's College, London, Arthur Henry Reginald Buller, professor of botany, University of Manitoba, Canada, Charles Drummond Ellis, university lecturer in physics, University of Cambridge, Ronald Aylmer Fisher, head of Statistical Department, Rothamsted Experimental Station, Harpenden, George Ridsdale Goldsbrough, professor of mathematics, Armstrong College, Newcastle on Tyne, James Gray (Cambridge), fellow of King's College and lecturer in comparative anatomy, University of Cambridge, Cyril Norman Hinshelwood, follow and tutor of Trinity College, Oxford, Augustus Daniel Imms, head of Entomology Department, Rothamsted Experimental Station, Harpenden, Peter Kapitza, assistant director of magnetic research, Cavendish Laboratory, Cambridge, William Dickson Lang, keeper of the Department of Geology, British Museum, John Mellanby, professor of physiology, University of London, Henry Stanley Rapor, professor of physiology, University of Manchester, Harry Ralph Ricardo, consulting engineer, Harold Roper Robinson, professor of physics, University College of South Wales, Cardiff, Frederick William Twort, professor superintendent of the Brown Animal Institution, London

THE place taken by some of the best of our English timbers and the increasing use being made in Great Britain of some of the finest quality Empire timbers is well shown in the great new building known as Imperial Chemical House, Millbank, London, a special view of which took place on Friday, Feb 22 Amongst the English timbers used are walnut veneers, chestnut, oak, sycamore, lime, and holly The Empire woods include Australian silky oak, Australian black bean, Rangoon teak, Indian laurel wood, British Columbian timber, Canadian maple, Canadian yellow pine, Canadian spruce, Tasmanian timber, and Honduras mahogany Of the English timbers, the chairman's room is panelled with English walnut veneers which it is said could scarcely be equalled by any other walnut veneers in the world Certain rooms on the same floor are panelled with English chestnut key jointed centres, built up plywood panels The conference rooms are panelled throughout with English oak which is of a higher quality than the finest Austrian wainscot oak The first floor conference room is panelled with Australian silky oak, a beautiful wood which should have a more extended use in England Another conference room is panelled with Australian black bean, the wood of which has a very beautiful figure This panelling has a Renaissance design

THE whole of the skirtings in the new building which is to house Imperial Chemical Industries, Ltd, including nearly 2½ miles of corridors, and in all the rooms with the exception of the panelled rooms, are made of English sycamore For the elaborate carvings in the Gibbons manner English limewood has been used, whilst English hollywood is employed for the inlaid work in certain bath and changing rooms and lavatories For dormer windows, staircases, and doors, teak is the timber employed The room to be used by Lord Reading, one of the directors, is panelled with Indian laurelwood, which shows the striking beauty of the unusual figure of this timber British Columbian timber has been used for the parquet flooring in some of the stories, including the great refectory Tasmanian timber is used in the basement, and Canadian maple for the flooring in the squash rackets and badminton courts Certain of the panelled rooms in white wood have been made from the best Canadian pine The backings for the best panels such as the walnut veneers, etc, are made from Honduras and West African mahogany Finally, the great flag staff, nearly 90 feet high, is made of Canadian Pacific coast spruce It will be apparent that this magnificent building provides an important object lesson in the utilisation of some of the finest timbers in the Empire

IT is satisfactory to note that the interest in the application of scientific methods to industrial problems is beginning to receive financial expression It was announced a few days ago that the trustees of the estate of the late Mr C Heath Clark had decided to make a contribution of £10,000 to the National Institute of Industrial Psychology for the promotion of education in London The problems connected with the application of psychology to industry fall into two categories (a) Those that involve the application of already well established generalisations to a particular problem, (b) those for which as yet no generalisation is known Employers are often quite willing to avail themselves of the help of the Institute for problems of the first order, but seem to be either unable or unwilling to help in the solution of those of the second for these involve the slow and laborious accumulation of data for which no immediate value can be assigned It is therefore necessary, if research is to go forward, that there should exist some fund which can be applied to problems involving more detailed study

THE Institution of Mechanical Engineers, before which Prof A S Eddington recently delivered the Thomas Hawksley lecture on "Engineering Principles in the Machinery of the Stars," was founded in 1847 at Birmingham with George Stephenson as its president Thirty years later its increasing activities led to its removal to London, and its present fine headquarters in Storey's Gate has been the scene of many notable gatherings The president this year is Mr R W Allen, of the Queen's Engineering Works, Bedford, while the president elect is Mr Daniel Adamson of Manchester Its membership is more than 10,000 and its income about £30,000 per annum It has initiated and carried out much important research work, it has representatives on numerous conferences, boards, and institutions, it maintains various provincial and overseas branches, and in conjunction with the Board of Education it conducts

examinations for National Certificates and Diplomas in Mechanical Engineering at more than one hundred technical schools and colleges The Thomas Hawksley Lecture was founded by the late Charles Hawksley (1839–1917) to commemorate the centenary of the birth of his father, Thomas Hawksley (1807–1893), one of the most distinguished waterworks engineers of his time, who served as president of the Institution of Civil Engineers and of the Institution of Mechanical Engineers One of the greatest works with which he was associated was the Lake Vyrnwy Scheme, North Wales, for the water supply of Liverpool

One hundred years ago a young musician, Louis Braille, blinded at the age of three, overcame his difficulty by the invention of a system of six dots whereby it was possible to emboss music, literature, and numerals Braille was born at Coupvray, near Paris, in 1809, and died in 1852, having been a pupil and for twenty six years a professor in the Institution des Jeunes Aveugles at Paris In connexion with the centenary of the invention, the National Institute for the Blind, which has issued millions of copies of music, books, etc , is appealing for funds for its work The appeal is addressed primarily to musicians, and it is proposed to have a performance of Mendelssohn's famous "Hymn of Praise," written in 1840 in connexion with the erection of the monument to Gutenberg on the fourth centenary of the invention of printing It is in this work that the words "The night is departing" occur

The first public school for the blind was established in Paris in 1784, the first in England was that at Liverpool opened in 1791, and the first in London dates from 1799 That in Paris was founded by Valentine Haüy (1746–1822), the brother of the famous crystallographer René Haüy (1743–1822), and it was Valentine Haüy who began printing in embossed characters for the blind Many men of science have suffered from blindness Galileo and Euler became blind Nicholas Saunderson, for a long time Lucasian professor of mathematics at Cambridge, was blind from the age of one, and H M Taylor, at the time of his death in 1927 senior fellow of Trinity College, Cambridge, did most remarkable work by translating mathematical volumes into Braille after he became blind at fifty two years of age The Belgian physicist Plateau became blind at the age of forty two, but with the aid of his wife and son continued to carry on his work in physiological optics and molecular physics, and at the age of seventy-two published a valuable contribution to the knowledge of capillary attraction

A new scientific expedition to the Antarctic under the leadership of Sir Douglas Mawson is now being organised The *Times* announces that the British government has given the *Discovery*, and that the Australian government is providing the necessary funds The government of New Zealand is also contributing The expedition is designed to explore the region between the Ross Sea and Enderby Land and to continue the work carried out in that area by Sir Douglas Mawson and Capt J K Davis in the Australasian Antarctic Expedition of 1911–14 Capt Davis is again to go with Sir Douglas Mawson and will be in command of the *Discovery* Much of the coast line towards Enderby Land is still unknown, and Enderby Land itself has never been visited since its discovery in 1832 Aeroplanes will be useful for inland survey The study of meteorological conditions will enable the relationships between the climates of Antarctica and Australia to be determined more accurately Much attention will be paid to the distribution of whales, in view of the spread of commercial whaling to those waters The expedition will sail from Australia towards the end of this year The combination of aeroplane reconnaissance and detailed ground work should result in discoveries of the highest value

A paper was read before the Surveyors' Institution on Feb 4, by Mr H J Vaughan, on "The Significance of the Timber Merchant in Estate Forestry" Mr Vaughan, who is now managing a large estate, in addition to taking a keen interest in the planting and growing of trees, has had the somewhat unique experience of having spent two years in close association with a large firm of English timber merchants in the south of England He says, in his opening paragraph, that "it seems to me that some even of our eminent foresters tend to lose sight of the saw bench when advocating and putting into practice schemes of afforestation or re planting" After glancing at the sporting and amenity aspects of woodlands, Mr Vaughan pointed out that what the timber merchant wants is a regular and trustworthy source of supply of his raw material, and that the management of private woodlands in the past has not fulfilled this desire This is the cause to some degreee of the low prices offered to owners for their trees, and for the high freights charged by railways for the carriage of timber After contrasting some of our best hardwoods with the softwood conifers, Mr Vaughan said he doubted whether Great Britain would ever be able to compete with tho Scandinavian countries in this class of material In discussing the work of the Forestry Commissioners and their concentration on planting softwoods and purchase of land for this purpose, Mr Vaughan expressed the opinion that it would be better to concentrate on growing hardwoods wherever possible, some of our native trees of this class having a real superiority, rather than to try to meet a questionable world famine with what is bound to be a very small proportion of our total requirements of coniferous softwoods for building and for constructional work Mr Vaughan considers it a wrong policy to plant conifers on areas where valuable hardwoods would grow

The Department of Entomology of the British Museum (Natural History) has recently received through Mr P A Buxton, of the London School of Hygiene and Tropical Medicine, specimens of a new genus and species of parasitic Hymenoptera (Ichneumonidæ), bred from the grubs of *Cladocera nigro-ornata*, a beetle used by the Bushmen of the Kalahari Desert, South Africa, as an arrow poison. The Trustees of the Museum have approved the purchase

for the Department of Geology of part of the skeleton of the horse like mammal *Moropus* This is one of the Chalicotheres, distantly related to the horses, which they resembled in their rather small head and long neck The fore limbs were long compared with the hind limbs, so as to give the trunk a giraffe like pose Like the horses, they were herbivorous, but they had claw like hoofs, three on each foot Chalicotheres have been obtained from early Tertiary times onwards, from Europe, Asia, Africa, and America Hitherto the Museum had only some incomplete remains from India, and a single claw from Central Africa The individual now acquired came from the Middle Tertiary of North America It stands as high as a large horse, but the bones are far more massive Recent additions to the mineral collection of the Museum include some crystallised sprays of native gold in calcite from Torquay, Devonshire, discovered and presented by Prof W T Gordon

Prof F O Bower, F R S, made "The Evolutionary Relation of the British Ferns" the subject of his presidential address to the Yorkshire Naturalists' Union at York on Dec 8 The address is published in full in the *Naturalist* for January 1929, and is of very great interest to British botanists, as the following citation will indicate "Having this year completed nearly half a century's research on 'Ferns,' and summed it up in three volumes in which the aim has been to reconstruct their chief evolutionary sequences upon a foundation of Organography, it seemed not inapt to use the present opportunity for placing our British Ferns in their probable relation to the Class at large I believe this has never yet been done" Both task and man were most apt to the occasion, a memorable one for the Union, a large meeting listened to a most delightful and stimulating address which did not restrict itself to the written word, but often diverged into a most interesting and relevant commentary upon the slides used in illustration, which were made from the plates of Sir William Hooker Prof Bower pointed out that in Great Britain we have only some forty species out of a total of 6000, but these are representative of half the families and about one eighth of the genera "This is probably the consequence of the position of Britain on the extreme fringe of a great continental area" Many of the largest fern genera are monotypic with us Prof Bower discussed this interesting fact, concluding that probably the majority of these British ferns "represent vestiges of a richer flora of the past, and that the species themselves have, by their more ready adaptation, or by more hardy constitution, been able to subsist in surroundings from which their congeners have retired beaten" "In fact, they symbolise the tenacious and adaptable race of men that inhabits these islands"

Prof J A Fleming gives interesting personal recollections of Sir Joseph Wilson Swan in the *Journal of the Institution of Electrical Engineers* for February in connexion with the invention of the carbon incandescent electric lamp In particular, he points out that one of the carbon incandescent lamps shown by Swan at an Exhibition in Newcastle on Tyne on Dec 18, 1878, is still preserved in the Science Museum at South Kensington It is necessary to distinguish between patent priority, which is often a mere matter of luck or promptitude, and that scientific or technical priority which is based upon achievements, exhibitions, public statements, or the evidence of contemporary workers Scarcely any invention springs into existence in full completion In many cases inventors may with justice claim to have originated some part of an invention It was thus with the invention of the electric lamp of small candle power The 'subdivision of the electric light' was the problem which the electricians of 1878 had to solve In 1879, Fleming was scientific adviser to the Edison Telephone Co, and in 1882 he was appointed in the same capacity to the Edison Electric Light Co and to the Edison and Swan Co In his opinion the credit for the epoch-making invention of the electric lamp cannot be solely attributed to T A Edison Sir Joseph Swan is, without doubt, one of those whose names are inscribed high up on the roll of fame For all future time his name will be connected with the invention of the carbon filament electric lamp

During the summer meeting last year at Glasgow of the Institution of Electrical Engineers, many members visited the works of the British Aluminium Co at Tulloch and Fort William The company has two hydro electric stations in operation, that at Foyers on Loch Ness, opened in 1896, and a second at Kinlochleven, on Loch Leven, opened in 1909, while a third and much larger one is being erected about a mile from Fort William This is not only of interest on account of its size and its various engineering features, but also as an example of the use of water power for manufacturing in a remote area dominated by the mountain Ben Nevis The most notable piece of construction has been the boring of the tunnel from the valve shaft at the Treig Dam to Fort William, 15 miles in length Commenced in the summer of 1926, the last shot opening the tunnel was fired on Feb 9, the work having proceeded from 23 faces by means of vertical shafts and horizontal adits From the surge chamber on the hill above Fort William the water will be conveyed by three steel pipes, at a maximum head of 800 ft, to the power house, which will eventually have turbines of a total capacity of 120,000 h p The catchment area is 303 square miles in extent, the rainfall over which varies from 50 inches per annum in the northern part to 160 inches on the summit of Ben Nevis A short description and a map of this important scheme was given in *Engineering* for July 6 of last year Though the tunnel is now bored, about half of it still remains to be lined with concrete

The Annual Summary of the World's Shipbuilding, issued by Lloyd's Register, is a statistical return of great value affording an indication of the progress of this great industry in all countries The summary for 1928 deals with the ships launched during the year, their tonnage, classes, types and machinery, and includes tables showing the tonnage launched for many

years back Shipbuilding is an industry liable to very great fluctuations, and one which, owing to the War, experienced great difficulties The fluctuations will probably always occur, for the demand for ships varies with many factors, but it is a satisfactory feature of last year's return to find that the tonnage launched in Great Britain and Ireland was 53 6 per cent of the world's tonnage of about 2,700,000 tons The tonnage launched in 1893 was about one million tons, in 1903 it rose to two million, in 1913 to three million, and in 1919 to more than seven million tons Of this seven million tons about half was built in the United States, but after 1921 shipbuilding in the United States sank to a much lower level, and last year the tonnage launched in that country amounted to only 86,000 tons The growth of the mercantile fleets of the world can be seen by comparing the total tonnage of 42,514,000 tons of 1914 with the 61,594,000 tons of 1928 Remarkable changes in ships have taken place also Oil tank ships in 1914 amounted to 1,479,000 tons, in 1928 to 6,544,000 tons , motor ships totalled 234,000 tons in 1914, and 5,432,000 tons in 1928 , while steamers fitted for burning oil totalled 1,310,000 tons in 1914 and 19,000,000 tons in 1928 The largest vessels launched during 1928 were the German Atlantic liners *Bremen* and *Europa*, of 46,000 tons each

WE have received the first number of the *Journal of Nutrition*, edited by J R Murlin, assisted by an editorial board of ten well known American experts in this branch of science It is to be published every two months by the American Institute of Nutrition, the president of which is E F Du Bois , at present one volume of about 500 pages will be issued each year The first number (September 1928) contains articles by H M Evans, "The Effect of Inadequate Vitamin B upon Sexual Physiology in the Male" and "Relation of Vitamin E to Growth and Vigour", by E V McCollum and collaborators, "The Distribution of Vitamin E" , by B Sure, "A Detailed Study of the Rôle of Vitamin B in Anorexia in the Albino Rat" , and by the editor, "Vital Economy in Human Food Production," etc , some of which we hope to refer to in more detail later The *Journal* is well got up, with a portrait of Lavoisier on the cover, and is clearly printed The science of nutrition has expanded so greatly in the last few years that there is undoubtedly room for another journal dealing solely with this subject , the composition of the editorial board should ensure that it maintains a high scientific outlook It can be obtained in Great Britain from Messrs Baillière, Tindall and Cox

AN article on the marine biological laboratory at Seto, Japan, its equipment and activities, with remarks on the fauna and flora of the environment, appears in the *Memoirs of the College of Science, Kyoto Imperial University*, Series B, vol 3, No 3 , 1927 The laboratory, which is affiliated to the departments of zoology and botany of Kyoto University, was opened in 1922 It consists of a number of separate buildings—an aquarium open to the public, a students' laboratory, two research laboratories, and a dormitory capable of accommodating thirty persons Up to-date equipment is installed throughout, and individual research rooms are furnished with electricity and running salt and fresh water For the collection of material the laboratory possesses, in addition to three rowing boats, one vessel of 19 tons capacity, fitted with masts and sails and equipped with a 25 h p semi Diesel gas engine Up to the present the staff has been engaged mainly in making faunistic surveys of the various collecting grounds A preliminary survey of the littoral and inshore areas has already been completed, but that of the deeper waters has not yet been fully worked out Spring and summer vacation courses —attendance at which is compulsory—are provided for students of biology at the University, and a summer course is also provided for teachers of biology in public schools

THE Report of the United States Coast and Geodetic Survey for the year ending June 30, 1928, in addition to the usual record of work, mentions several new features The demand of air maps has led to a new branch of the department's work Already several sheets of recognised flying routes have been published and others are in preparation A big development in this branch of survey work is anticipated In coast surveys considerable use is now being made of echo sounding with the fathometer, for which the claim is made that it allows work to be done twice as quickly as by any other means It is now used in eight survey vessels which can work at full speed, and stop only when temperatures or water samples are required In connexion with echo sounding, a further development is sound ranging in order to fix positions in thick weather The use of this method allows hydro graphical work to be continued almost regardless of weather conditions and throughout the twenty four hours The report gives a number of charts showing the state of field work up to the end of the year under consideration

THE recent series of illustrated post cards of British trees issued by the Natural History Museum, as F 22—F 28, contain excellent photographs and illus trations of trees, long familiar in Great Britain, if not necessarily native In each series two photographs show the appearance of a fine example of the tree in winter and in summer, whilst two more coloured illustrations depict and analyse flower and fruit These cards, with their accompanying descriptive leaflet, together with an exhibit of British grown trees in a bay in the Central Hall of the Natural History Museum at South Kensington, to which the leaflet refers the reader, should help to make the city dweller more alive to the beauty and interest of the trees of the countryside

APPLICATIONS for the Government Grant for scientific investigations must be made to the clerk to the Government Grant Committee, Royal Society, Burlington House, W 1, upon the requisite form, by Mar 31

DR KARL JORDAN, curator of the Entomological Department of the Zoological Museum at Tring, has been elected president of the International Commission

on Zoological Nomenclature in succession to Prof F C Monticelli, deceased Prof Filippo Silvestri, of Portico, Italy, has been elected a member of the Commission in succession to the late Prof F C Monticelli, of Naples

THE new year issue of *The Fight against Disease*, the organ of the Research Defence Society, reminds us that the Society has now been in existence for twenty one years An interesting correspondence between Lord Knutsford and the Hon Stephen Cole ridge on diabetes and insulin treatment appears in this number

A CATALOGUE issued by Mr Francis Edwards High Street, Marylebone, of books on the voyages of Captain James Cook, contains several items of great interest One entry is the original painting by J Webber who was artist in the *Resolution*, of the death of Captain Cook in Hawaii This picture is well known from the engraving by Bartolozzi Another item is the manu script log book of H Roberts, who as mate of the *Resolution* was in charge of the pinnace which took Captain Cook ashore for the last time The log runs from October 1778 to November 1779 when Capt King demanded for the Admiralty all log books and diaries kept on board the ship

APPLICATIONS are invited for the following appoint ments on or before the dates mentioned —An assist ant in the Electrical Engineering Department of the Coventry Municipal Technical College—The Director of Education, Council House, Coventry (Mar 8) A head of the Building Department of Rutherford Tech nical College, Newcastle upon Tyne—The Director of Education, Northumberland Road Newcastle upon Tyne (Mar 9) A head of the Engineering Depart ment of the Technical Institute, Gillingham—R L Wills, 15 New Road Avenue, Chatham (Mar 9) A woman lecturer in education in the Department of Education of the University of Bristol—The Secretary, Department of Education The University Bristol (Mar 11) A lecturer in engineering at the Tech nical College East London, South Africa—The High Commissioner for the Union of South Africa South Africa House, Trafalgar Square W C 2 (Mar 12) A Tancred student in physic at Gonville and Caius College, Cambridge—E T Gurdon 28 Lincoln s Inn Fields, W C 2 (Mar 12) A director for the Harcourt Butler Institute of Public Health Rangoon—The Secretary to the High Commissioner for India, General Department 42 Grosvenor Gardens S W 1 (Mar 13) A professor of botany in the University of Birmingham—The Registrar The University, Birmingham (Mar 16) A horticultural lecturer and adviser under the Bucks County Council—The Agricultural Organiser Education Sub Office, Aylesbury Bucks (Mar 16) A professor of philo sophy in the University of Lucknow—The Registrar The University Lucknow (Mar 17) An assistant lecturer in economics in the University College of North Wales The Registrar University College of North Wales Bangor (Mar 18) An assistant inspec tor in connexion with agricultural and horticultural education and research—The Secretary Ministry of Agriculture and Fisheries 10 Whitehall Place, S W 1 (Mar 18) A lecturer in metal mining in the Mining Department of the University of Birmingham—The Secretary The University Birmingham (Mar 23)

ERRATUM Obituary of Dr J W L Glaisher in NATURE of Jan 26 p 135 col 2 line 8 from bottom for 1910 read 1901

Our Astronomical Column

SPECTRA OF MINOR PLANETS —*Lick Observatory Bulletin*, No 407, contains an investigation of this subject by Mr N T Bobrovnikoff, he used a one prism spectrograph on the 36 inch refractor As might be expected, the light of the small planets is wholly reflected sunlight, there are no absorption bands as in the giant planets The violet and ultra violet regions are generally very weak as compared with the spectra of *G* type stars There is evidence of difference of composition of different planets, thus Ceres is bluer than Vesta, the maximum of intensity of the latter being much further towards the red end, the values given are Ceres, λ4800, Vesta, λ5300 It has been deduced both by changes of light and of spectrum that Vesta rotates in $5^h\,55^m$ The sugges tion is made in the article that minor planets may be comets that have lost their gaseous envelope, but it should be remembered that Halley's comet was in visible when in transit over the sun in May 1910, whereas any solid body of even a few miles in diameter would have been detected, the comet being near the earth

MAGNITUDES OF STARS IN THE CAPE ZONE CATA LOGUE —The importance of the accurate determina tion of magnitudes both for statistical purposes and for the deduction of spectroscopic parallaxes has been more fully realised during the last two decades The Cape Observatory has lately published a volume which gives the photographic magnitudes of 20,843 stars in the Cape Zones (Declination − 40° to − 50°) the Harvard spectral type and photometric and photographic magnitudes being given for comparison

Very careful experiments have been made at the Cape of the photographic effects of different exposures different intensities of light and different brands of plates Kron gave an exponential formula with different values of the exponents for different brands of plates This is adopted with the simplification that Kron s α_1 α_2 are each assumed equal to 0 25 for all brands of plates The quantity *I*, known as the optimal intensity, is, however, considerably greater in slow than in fast plates The mean difference (irrespective of sign) between Cape and Hertzsprung is 0 07 mag, the difference from Harvard for 16 stars in the south polar sequence is + 0 07 mag

The satisfactory conclusion is reached that if there is on a plate one star the magnitude of which is known from extraneous sources, the magnitudes of the other stars on the plate can be deduced The zero point of the Cape system was derived from the Harvard visual system corrected for colour There is found to be a marked tendency for the colour indices to group themselves round four maxima the positions of which are − 0 04 mag, + 0 38 mag, + 0 84 mag, + 1 30 mag It will be seen that they are nearly equally spaced

Research Items

DUGONG FISHING IN MADAGASCAR —M G Petit publishes in the *Bull et Mém Société d'Anthropologie de Paris*, T 8, Sér 7, fasc 4 5 6, some further observations on the ritual of dugong fishing in south west Madagascar Small light outriggers, extremely mobile, are employed, the fishermen being two in number to each, a harpooner who stands in the bow being in command Before setting out, the harpooner consults the *Sitily* as to whether conditions are favourable, and he is provided with a talisman (*Ody*) This is used first to consecrate a vessel of sea water, and is then placed in the prow and covered with a piece of old net to protect it The sea water is used to sprinkle the canoe, while invocations are addressed to it, and to the harpoon and its ropes It is also used to wash the head and hands of the fishermen As soon as the day for fishing has been fixed, the fishermen must abstain from all contact with their wives, and must not touch food prepared or water drawn by them The fishermen are in fact in a magical state, of which the serious nature is indicated by the fact that to miss the dugong not only entails misfortune for the village, but will be followed by the death of a member of the fishermen's family When the animal has been brought to land, its body is scrupulously hidden from the sight of women and children The body is dismembered by an old man, and the blood carefully collected and divided into three parts, one poured on the sand by the canoe, one into the sea, and the third smeared on the prow of the canoe the harpoon and the rope The flesh is eaten on the beach, first by men and, when they are satisfied, by women and children, but no knife, fork, or other utensil must be employed, nor must anyone spit or blow the nose The carcase must be buried, this being done with ceremony, as neither beast nor bird, but only man, must eat the flesh or pick the bones If the animal is female, connexion is enjoined on the fishermen, a custom which is found on the east African coast, and in a Chinese account of the Aino of Sakhalin in relation to women fish, presumably seals

THE STARLING IN THE UNITED STATES —The European starling, set free in New York in 1890 and 1891, has since 1910 spread rapidly throughout the United States, so that it seems likely to colonise all the country east of the Rocky Mountains, and, should it pass the Continental Divide, to prosper also on the Pacific coast With such an extension of range possible, it is important that the economic influence of the bird should be properly understood, and E R Kalmbach supplies the needed information in a U S Department of Agriculture *Farmer's Bulletin* (No 1571, December 1928) His conclusion is that most of the starling's habits are either beneficial to man or of a neutral nature Field observation has established the fact that the time spent by starlings in destroying crops or in molesting other species of birds is extremely short compared with the endless hours they spend searching for insects or feeding on wild fruits It is admitted that the bird damages cherries and certain other small fruits, and that its roosting habits make it objectionable in cities, but it is claimed that these are the results of overabundance rather than pronounced tendencies for harm on the part of the individual bird Such conditions are local and should be remedied by local control, such as the destruction of the roosts, or if that be not possible, by fumigation—a tricky and perhaps dangerous proceeding —or on a small scale by trapping

EVOLUTIONARY SIGNIFICANCE OF PARASITES — Prof R Hegner (*Quart Review Biol*, 3, 1928) discusses the protozoa found in man and in monkeys He states that of the four genera of amœbæ that live in man, three are represented in monkeys and the fourth has probably not yet been discovered on account of its rarity Four of the six well authenticated species of human amœbæ are indistinguishable from four of the species found in monkeys Among the intestinal flagellates of monkeys are five species that are indistinguishable from five of the seven species which live in man The ciliate *Balantidium coli* which lives in man is probably the same species that has been recorded from various species of monkey All three species of human trypanosomes seem to be present as natural parasites of monkeys, but the Leishmanias have not been reported from monkeys Malarial parasites that occur in monkeys resemble the three species that live in man Thus sixteen of the twenty five species of human protozoa have been described from monkeys One genus of ciliates (*Troglodytella*) and one *Babesia* occur in monkeys but not in man Comparison of human protozoa with those of mammals other than monkeys shows that they can be distinguished without difficulty, for example, the intestinal amœbæ and flagellates of the rat and the rat trypanosome are not identical with any species of human protozoa If the proposition is valid that close relationships of parasites indicate a common ancestry of their hosts, then the facts available furnish evidence of importance in favour of the hypothesis that monkeys and man are of common descent

FISH STATISTICS FROM LATVIA —The Section of Fish and Fisheries Industries of the Ministry of Agriculture has continued its fish statistics for 1927 in Latvia (*Bulletin statistique des pêches maritimes de Lettonie* Année 1927, Rédigé par V Miezis, Riga, 1928) The report is in Latvian and in French Tables are given relating to the various catches in the years 1924–27, for the months in 1927, giving the total weight in kilograms of the fish taken and their money value, the quantity of fish month by month in 1927 and according to districts, details of the boats and gear, number of fishing days, and the state of the fishing each month, also the number of seals killed is included (84 in 1927, mostly from the Kolkas region) At the end there is a useful list of the names of the fish in Latin, Latvian, French, German, and Russian Herring form the largest part of the fishery, then flat fish, salmon and salmon trout, cod and *Zoarces viviparus* being sometimes in greater numbers than the salmon Sprat and eels are also caught The herring fishery for 1927 is the largest of the four years, the other years in order being 1925, 1926 and 1924, the order for flat fishes and turbot is 1926, 1925, 1924 and 1927

HALOGEN COMPOUNDS AND TOAD TADPOLES —Mr Shinryo Ohfuchi describes the effect of chlorides, bromides, and iodides, and also of feeding with thyroid substance, on the toad *Bufo vulgaris formosus* ("Effect of Halogen Compounds on the Growth of the Tadpole of *Bufo vulgaris formosus* B" *Science Reports of the Tôhoku Imperial University*, 4th Series (Biology), Sendai, Japan, vol 3, No 4, Fasc 1, 1928) The halogen compounds, sodium and potassium chlorides, bromides, and iodides, were mixed with the pond water in bowls, and algæ were given in every vessel All the tadpoles were fed on cow's liver, except those fed on the thyroid extract Liver and each culture medium, with algæ, were renewed every day It was found that, in general, chlorides tend to accelerate the growth of the body at first, later to retard Bromides

retard at first, later accelerate. Iodides retard the growth of the trunk and hind limbs but tend to increase the tail dimensions, thus indicating a longer period during atrophy of the tail. Metamorphosis is hastened by feeding with extract of thyroid, but potassium iodide in the water does not have the same effect.

MOLLUSCA FROM NEW ZEALAND.—Mr. A. W. B. Powell in two papers describes three new volutes and five new land shells from New Zealand (*Proceedings of the New Zealand Institute*, vol. 59, Part 2, 1928). The larger recent volutes of New Zealand are separable into two main groups, one occurring in shallow and the other in deeper water. Two of the new species belong to the first group, the members of which show much variation and are characterised by a projecting callus plate on the columella, the deeper water species having none. The radula of the Volutidæ is of a simple degenerate type, but it is possible to detect slight differences in the single central tricuspid tooth which remains in nearly all species. These differences in shape of base and length of cusps help the author to separate the species, but as the teeth of the radulæ of other molluscs are known to be variable, it is well to be careful in attributing importance to these slight differences until many specimens have been examined. The land shells described in the second paper are interesting, but the shells only are described. *Murdochia aranea* is a beautiful little snail with delicate white riblets showing up on a reddish brown background. *Cavellia spelæa* is the largest species of the genus as yet found, measuring 5.25 mm. across. It is a sub-fossil species found in a cave together with *Moa* bones, and also with the common bush snail *Charopa coma*.

GROWTH REGULATING ACTION OF THE LEAF.—R. Dostál has of late years developed a theory as to the significance of the metabolism of the leaf as a correlating influence upon growth. Whilst some striking experiments have recently been described by this worker, in which the normal periodicity of scale and leaf production in the annual cycle of the leafy shoot of the tree has still been maintained under very exceptional external conditions, many of the experimental data which were associated with the development of this view will be found in a long paper published in the *Acta Soc. Scient. Nat. Moraviæ, Cechoslovakia*, 3, 83-210, 1926. In general, his view is that the growth of the axillary or terminal shoot primordium is very much influenced by the metabolism of the subtending leaf, and he examines the various marked changes in development of the shoot that follow upon mutilation or other experimental modification of the normal activity of this leaf. He also analyses, in experiments with *Circæa intermedia* and *Scrophularia nodosa*, the different morphogenetic quality of different regions of a shoot, as exemplified by the different results obtained when similar regeneration experiments are carried out with isolated nodes from different regions of the same shoot.

GRASS FIRES AND PLANT SUCCESSION IN SOUTH AFRICA.—During the present year the vegetation of South Africa will have, perhaps, a special interest to many readers of NATURE, and attention may be directed to the memoirs on the Botanical Survey of South Africa, which are being issued by the Department of Agriculture under the general direction of Dr. I. B. Pole Evans, Director of the Botanical Survey. *Memoir* No. 12, recently issued, by Ernest E. Galpin, upon the Springbok Flats, raises in an interesting manner one very controversial South African problem—the practical significance of annual burning of grassland. Galpin's conclusion is that acacia trees will gradually spread over the whole Springbok Flats, so that the grassland will become more or less dense acacia scrub. The cause of this change of vegetation is traced in a large measure to the suppression of the custom of annual veld burning, as European methods replace traditional native ones. The soil probably increases in humus with the suppression of the fires, but if the result is too intractable acacia scrub, it may be unfortunate, and the traditional native practice of burning thus prove to be justifiable. On the other hand, on the poorer grassland of the neighbouring veld, which stands higher than the rich loams and fertile grasslands, burning seems to be a very harmful practice. The wind then catches the exposed surface of the sandy soil and carries it forward, so that the sand veld is encroaching on the richer cultivable land as the result of frequent fires. Galpin has described a very interesting and rare new plant, *Cucumis humofructus*, Stent, which buries its fruit in the ground as it ripens as the result of negatively geotropic growth curvatures in the stalk.

CHLOROPHÆITE AND PALAGONITE.—The discussion of the nature of these and related mineraloids and of the terminology to be applied in specific cases, is continued by Martin A. Peacock and R. F. Fuller in the *American Mineralogist*, July 1928, and by L. L. Fermor in the *Rec. Geol. Surv. India*, Part 2, 1928. Dr. Fermor presents a general formula—

$$2\tfrac{1}{2}H_2O \cdot 5R_2O_3 \cdot 20SiO_2 + n(RO \cdot H_2O) + (80 - 4n)H_2O$$

—representing a series in which not only chlorophæite and palagonite find a place, but also certain other amorphous or micaceous minerals. The two other authors claim that ferric oxide is strongly dominant in chlorophæite, whereas alumina is abundant in palagonite. The former they regard as a result of hydrothermal action on basic constituents of basalts and dolerites, whereas palagonite is interpreted as a gel produced by the hydration of sideromelane. They propose that sideromelane should be retained as a specific name for clear, pale coloured basaltic glass as distinct from tachylyte, which is deep brown, opaque, and even microscopically turbid. Fermor, advocating the view that palagonite falls within the chlorophæite series, naturally points out that the term chlorophæite has twenty years' priority, and should therefore be adopted as the mineraloid name. Palagonite, he thinks, should be used as a rock name, and sideromelane he regards only as a variety of tachylyte. Much of the existing confusion doubtless arises as a consequence of basaltic alteration products and mesostatial material having been called palagonite when terms like chlorophæite and delessite would probably have been more appropriate. Chlorophæite, in the sense of Peacock and Fuller, is now a well established term, but palagonite can no longer be used without a careful explanation of what it is meant to imply.

ATMOSPHERIC OZONE.—The issue of the *Proceedings of the Royal Society* for Feb. 4 contains Dr. G. M. B. Dobson's third report of the work of himself and of his collaborators on the ozone of the atmosphere. In this they have been mainly concerned with the fluctuations of the ozone content in typical cyclones and anticyclones, and their extensive data are summarised in a convenient set of maps and tables which, apart from their intrinsic interest, should be of great value when they can be subjected to detailed analysis in conjunction with other meteorological records. Dr. Dobson has already found at least two important connexions with other phenomena. One of these, which was suspected previously, and has now been confirmed, is that there is a small but definite tendency for days with much ozone to be associated with

magnetically disturbed conditions The other has been found by studying the ozone records in relation to the movements of the large air masses, as diagnosed by the Norwegian Meteorological Institute It appears that polar air has a high ozone content and tropical air a low ozone content, and since the weather records are essentially obtained from data which refer to the troposphere whilst the centre of gravity of the ozone layer is probably at a height of from forty to fifty kilometres, the ozone measurements thus give evidence that the large tropical and polar air currents extend to a great height and bring their own stratosphere with them The study of cyclones and anticyclones has now been abandoned, as it is felt that further work in this field must be left to larger organisations, and the recording instruments have been sent to a number of scattered stations in the northern and southern hemispheres, in an attempt to find how the ozone varies over the surface of the earth

TWO MILLION VOLT BATTERY —At the Trafford High Voltage Laboratory of the Westinghouse International Co there is now in operation a two million volt battery which is used for testing the strings of insulators used for suspending the transmission lines on 220 kilovolt systems The pressure obtained is not an alternating pressure obtained by transformers but a unidirectional damped discharge Instead of using ten groups of condensers as was done last year, twenty are now used They are charged in parallel by means of large thermionic power tubes and discharged in series In order to measure the voltage, the spherical electrodes have each to be fifty nine inches in diameter The set is of great use in determining the performance of lightning arresters and in the design of cable and transformer insulation to withstand electric surges due to lightning or other causes The shape of the protective rings round the strings of insulators used on 220 kilovolt systems was determined by experiment, very definite results being obtained In addition to their electric tests, the strings of insulators are subjected to a mechanical tension of 20,000 lb A descriptive note of this battery is given in the *Westinghouse International Magazine* for February under the heading of the "World's Most Powerful Lightning Generator"

THE SHAPES OF MOLECULES —The effective area which a molecule presents to a slow electron depends very markedly on the relative velocity of the two particles, and it has now been shown conclusively that, quite apart from the excitation of quantum transitions, classical kinetic theory cannot account for the nature of the collisions, and fails in particular to explain the apparent transparency of many substances for very slow electrons In the first number of the new series of the *Annalen der Physik*, E Bruche has given a review of the results obtained up to the present in this field, including a description of his own recent work upon ammonia and water vapour The collected curves showing the molecular area as a function of the speeds of the incident electrons are very instructive, and exhibit regularities which indicate that the details of the collisions are determined both by the atomic constitution of a compound and by the structure of its outer shell of electrons Perhaps the most remarkable of these is the close correspondence between the curves for methane and for krypton Dr Langmuir and Prof A O Rankine had already commented upon this similarity in other connexions, and more recently it has been found that their ionisation potentials are also not much different, being 13 volts for the atom, and 14 6 volts for the molecule This resemblance to an inert gas evidently indicates that the molecule of methane possesses a high degree of symmetry, and, in the opinion of E Brüche, affords good evidence for the old model for methane in which the four hydrogen atoms were placed at the angular points of a regular tetrahedron, and the carbon atom at its centre

FIREDAMP EXPLOSIONS WITHIN CLOSED VESSELS —The Safety in Mines Research Board has previously studied the effects of firedamp explosions within closed vessels, such as the casings of electrical switch gear, but has now extended this investigation to explosions in vessels divided into intercommunicating compartments (S M R B, Paper No 49, by C S W Grice and R V Wheeler London H M Stationery Office) Beyling, in Germany, has shown that the ignition of an explosive mixture in one compartment may cause a considerable rise of pressure in another, and this result has been confirmed An explosion of a mixture of firedamp and air in a comparatively large volume and propagated through a narrow opening into a smaller compartment, may lead to the rapid development of a high pressure, and violent explosions can be caused in this way by even weak mixtures of methane and air Casings containing inter connected compartments are therefore unsuitable for use in mines

PROPERTIES OF BREEZE AND CLINKER AGGREGATES —Further work that has been carried out on breeze and clinker aggregates is described by F M Lea in *Bulletin of the Building Research Station*, No 5 (London H M Stationery Office) The properties of such aggregates are dependent upon the amount and nature of combustible material present Unburnt or partially burnt coal in breeze or clinker concrete is a frequent cause of failure, and the presence of only 4 per cent of coal may be responsible for serious damage The coal causes expansion of the concrete during setting and maturing, and ultimately cracking results Small quantities of sulphur do not appear to cause appreciable disintegration, although they may increase the rate of corrosion of reinforcement in the concrete The presence of dust in the aggregate results in a longer period of setting, since more water is required for mixing purposes, but does not cause subsequent unsoundness The *Bulletin* also describes methods of sampling and testing breeze and clinker aggregates in the field

THERMAL DECOMPOSITION OF AMMONIA —Baly and Duncan (1922) claimed that ammonia gas obtained by rapid evaporation of the liquid is less rapidly decomposed by a hot platinum wire than that produced by slow evaporation This effect was attributed to the existence of two kinds of molecules in equilibrium in liquid ammonia, all the molecules being assumed to pass into the form with the higher energy content on slow evaporation, while on rapid evaporation the equilibrium was supposed to persist in the gaseous state This work has been repeated by W A Stringfellow, who describes his results in the *Journal of the Chemical Society* for January These results do not confirm those of Baly and Duncan, practically no effect being observed in place of a 25 50 per cent decrease in reactivity with rapidly evaporated ammonia The addition of water vapour did not produce the great increase in decomposition observed in the earlier work Stringfellow suggests that as Baly and Duncan apparently did not exhaust their reaction vessel before filling it with ammonia, a rapid inflow of gas would not sweep out the air so completely as a slow stream The presence of adsorbed gases on the platinum wire might then account for the inhibition of the reaction observed when rapid evaporation took place The existence of different species of gaseous ammonia appears to be very unlikely

Cruise of the *Carnegie*.

THE non magnetic yacht *Carnegie*, which left Washington last May for a three year magnetic and electric survey of the oceans, has now completed the first unit of her voyage—that of encircling the North Atlantic In three letters to the Carnegie Institution of Washington (published by the Press Service Bureau), Captain Ault, who is in command both of the ship and of the Expedition describes the progress of the work so far accomplished The first place was Plymouth, reached only after encountering severe storms, then Hamburg, Iceland, Greenland, Newfoundland and Barbadoes Oct 9 was the date planned for arrival at Panama, and as these letters were being finished the ship was about 140 miles from that place, and the date was Oct 9, thus keeping well to the schedule

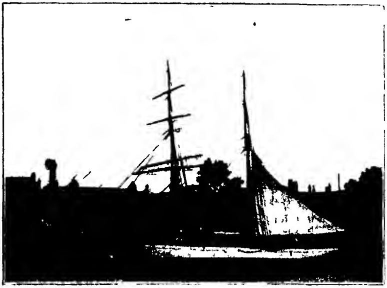

FIG 1—The *Carnegie* at Plymouth

The work is in full swing In this cruise a large amount of additional research in physical oceanography and biology is undertaken Every other day a magnetic station is occupied for compass declination, inclination, and horizontal intensity On alternate days an ocean station is occupied for water samples (salinity, hydrogen ion concentration, phosphate content, oxygen content) and temperature, with, occasionally, bottom samples and tow nets

The magnetic declination or compass variation at 135 stations has been determined, and the inclination and horizontal force at 49 stations, mostly near stations of former cruises Atmospheric electric observations have been made daily and many photographic records of continuous daily changes in the electric potential gradient also eight 24 hour series of observations of conductivity, ionic content and penetrating radiation Three hundred and thirty determinations of the depths of the sea have been made with the sonic depth finder This electrical apparatus for measuring the depth of the ocean floors records the time required for sound waves, from an oscillator mounted on the hull below the water line, to reach bottom and be reflected back to the surface Checks with the wire soundings show that the accuracy of the depth finder is within expected limits

For biological studies, tow nets at surface, 50 m and 100 m depth are taken, and the new Pettersson plankton pump, after several improvements, has been included as a regular instrument at each ocean station This is so arranged that it can be worked at a given depth by the release of a 'messenger,' the power being supplied by a 30 pound weight on the end of 100 m of wire wound on a reel on the pump 150 litres of water is strained through a small silk net attached to the pump When all the wire has run out the pump is closed off and hauled to the surface Salinities are now determined by means of the salinity bridge by the evening of the day on which the samples are taken Continuous records of both wet bulb and dry bulb temperatures or change of humidity at three positions have been secured The 'boom walk,' as used by Beebe (two 30 foot booms with net between extending from the ship's side), enables the naturalist to walk out over the water and use the dip net and tow nets outside the disturbances caused by the wash of the ship

On Aug 7 a station was occupied at the edge of the Grand Banks of Newfoundland in the cold Labrador Stream, which at that point had a depth of 130 m At the surface the temperature was 52° F, but at a depth of only 170 feet the thermometer fell to 34° Three days later in the Gulf Stream the water surface temperature was 79°F

Those who have seen the stores of spare apparatus on board have possibly marvelled at their numbers, careful provision fully justified when one realises the risk of loss every time an instrument is used One

FIG 2—Working the Pettersson plankton pump

such instance is recorded by Dr Ault, when a bottom sampler, eleven Nansen water bottles, and twenty two deep sea reversing thermometers were lost by the breaking of a wire about 2½ miles down

The *Carnegie* is happy in having contact by radio with America, England, France, Holland, and Germany

The Expansion of Telephone and Supply Systems.

THE problems that arise in connexion with the expansion of telephone systems are in some respects analogous to the corresponding problems in the supply of electric lighting. The Institution of Electrical Engineers therefore arranged on Jan 10 that papers on each of these subjects should be read at the same meeting so that the solutions adopted by the telephone engineers might be compared with those adopted by the supply engineers. The title given to each paper was "The Anticipation of Demand, and the Economic Selection, Provision, and Lay out of Plant"

Mr. J G Hines discussed the telephone system and Capt Donaldson the electric power system. The first problem that has to be solved in both systems is the forecasting of the probable number and distribution of subscribers that will exist in a given area at a given time. Once this is settled, the provision of a lay out which will ensure an efficient service at a minimum cost over this period is a technical problem which should admit of a rigorous mathematical solution

Secondary problems arise, however. In connexion with telephony there is the 'busy hour,' and in connexion with electric supply there is the 'peak load' In trunk line telephony the difficulty is sometimes met by having a special tariff so as to induce subscribers to communicate at the less busy hours, and occasionally, in electric supply, by means of meters which register more rapidly at stated times. There are many points of dissimilarity between the two problems. When a house has been wired for the electric light, it is most probable that there will be always a user in that house. In the case of telephone supply, especially in private dwellings, a change of occupier usually results in the telephone circuit serving the premises being given up. This involves recovery of the apparatus and the temporary or permanent abandonment of all the internal wiring which is always provided by the Post Office

In large cities high class property is often found next door to poor dwellings. Before the period covered by the Post Office forecast has expired, the smaller properties may be pulled down and replaced by blocks of flats or business premises, each requiring many telephones. It is necessary, therefore, to make detailed inquiries about possible alterations to property. Certain businesses like stockbroking and book making are very fluctuating. When there is a rush of work the number of telephones may be increased five times, and then when the depression comes they are given up

The data given show why overhead transmission is desired by engineers. A wire made of cadmium copper and weighing 40 lb per mile used overhead has a speech transmission efficiency equal to that of a 200 lb per mile underground cable. Public authorities, however, are increasingly reluctant to give permission to erect poles in public footways. Capt Donaldson said that the telephone problem is the more difficult, because each consumer must have his own individual pair of wires at least so far as the first telephone exchange

If the electric lighting stations built twenty five years ago had been ten times larger, it would have been in the country's interest. The replacement of reciprocating engines by the turbine has made it possible to accommodate considerably larger units of supply in the original engine rooms, but in many cases considerable alterations have had to be made. Capt Donaldson pointed out the fallacy of always replacing an engine by one of double the size, it is always necessary to assume that one engine may be out of commission. Hence the maximum reserve of power is obtained when all the engines are of equal size. The general situation is rapidly passing out of the hands of the smaller undertakers. Power engineers by careful study of the yearly loads can make reasonably accurate forecasts of the demand for some years in advance

The Rubber Research Institute of Malaya

THE first issue of the *Quarterly Journal of the Rubber Research Institute of Malaya*, Kuala Lumpur, January 1929, bears witness to the very active steps that have been taken to put the new Research Institute into working order. The director, Dr G Bryce, arrived in Malaya to take up his duties in September 1926. Some local appointments were made during the autumn of that year, and the other officers of the station were gradually brought in during 1927 and 1928, the seventeenth appointment being made in November 1928. By June 1927 the heads of the chemical, pathological, botanical, and soils divisions of the Institute were appointed, and engaged in visiting the neighbouring rubber research stations in Sumatra and Java. Temporary laboratory accommodation was provided by adapting a bungalow, and four months after the arrival of the heads of divisions in Malaya they had presented programmes of work for their respective divisions for the consideration of the Board of Control

In this first issue of the *Quarterly Journal*, brief summaries of the work of the different divisions are given, for the period up to Sept 30, 1928. These show that the officers appointed have lost no time in grappling with the many sided problems presented by the commercial cultivation of the rubber plant, and the preparation of the latex for market

The bulk of the journal consists of articles by various officers of the Institute upon many of the interesting problems that arise in connexion with research upon the growing and preparation of rubber. Besides being of interest to the rubber planters, many of these articles have special interest to botanists, colloid chemists, and other investigators of agricultural and industrial problems, who are not directly concerned with the rubber industry. Occasionally, however, a certain obscurity of expression makes some of these articles difficult to follow and particularly if the Research Institute wishes to carry interested growers with it in its investigations through the medium of its journal, it would seem worth while to expend more time and trouble upon the form in which these investigations, often themselves of great intrinsic interest, are described in print

Dr Haines discusses a topic of very general interest in countries with a tropical rainfall when he reviews the pros and cons of methods of silt pitting as a means of defence against excessive soil erosion. Experience which this investigator obtained in the classic experimental fields of Rothamsted is here utilised to visualise a soil problem specially characteristic of tropical and sub tropical conditions. The botanical division reports much active work upon vegetative propagation. Mr Mann, fresh from his contact with methods of

fruit culture at the Experimental Station at Long Ashton, near Bristol, discusses the conditions governing successful bud unions in Malaya, where vigorous growth of shoot and scion at the time of union, together with fair humidity in the weeks following the budding operation, seem the most essential conditions for success

Messrs A R Sanderson and H Sutcliffe give an account of some very valuable selection work on rubber they have had in progress before the formation of the Institute These experiments confirm the general impression that the selection of high yielding stock on any other basis than the yield of dry rubber over a long period of tapping, can, as yet, only be made with considerable uncertainty

The creation and propagation of high yielding strains —which Dr Weir, the head of the pathological division, reminds the reader may be at any time required endowed with resistance to some newly introduced pathogen, such as the South American leaf blight, which Dr Weir has studied in its native habitat—can obviously not be neglected by the Rubber Research Institute Mr Morris states that during a season's observations no pollen carrying insect has been seen to visit the female flowers of *Hevea*, which, it must be remembered, is not of Malayan origin, but an introduced plant isolated from its normal insect visitors Artificial pollination is successful between various selected clones, and a few seedlings have thus been obtained for further trial, but self pollination within the clone is usually negative in result The further analysis of the conditions, both internal and external, that contribute to successful pollination and fertilisation, is a promising field of investigation

Many other points of detail as to the chemical properties of the rubber, its preparation and various commercial defects, diseases of cover crops, of young, budded plants, etc , are dealt with in this first number of the new journal There is no doubt that if this standard is maintained the *Quarterly Journal* of the new Rubber Research Institute will be a publication of permanent scientific value

Association of Technical Institutions

THE annual general meeting of the Association of Technical Institutions was held in the Grocers' Hall, London, on Feb 22 and 23 As is customary, the installation of the president took place at the opening session, and, distinguished as have been the occupiers of the presidential chair in the past, the new president, Sir J E Kynaston Studd, is one of whom the Association may be justly proud By a happy chance, the year of his presidency coincides with his year of office as Lord Mayor of London But it is not only the civic honours that are his which distinguish him in and qualify him for his new office For some years now his activities in connexion with the Regent Street Polytechnic, of which he is president, have been well known

Since he was therefore in a position to speak to the Association as an expert, Sir Kynaston Studd's presidential address was expected to be one of unusual authority Nor was his audience disappointed His review of the work of such recent committees as the Balfour Committee on Trade, the Malcolm Committee on Education and Industry, and the Emmott inquiry into technical education and industry, was broad and illuminating The conclusion he drew from the reports of these committees may be summarised by saying that, although the Board of Education is now in a position as a result of the work done to do much to help technical education to attain the greater place it merits in our system, a great deal of the task of getting industry to come more and more to the technical college for informed help must be borne by such associations as the A T I In connexion with all this, he did not attempt to minimise the work done by the Atholl Committee on Examinations, but it was clear that he was closely in touch with the views of the majority of those engaged in technical education when he suggested that examinations are the least important part of the work of technical education We were glad, too, to note that he pressed home a vital point to which attention has already been directed in these columns (see NATURE, Nov 12, 1927, p 681, and July 28, 1928, p 121)—the status of the craftsman must be equal to that of any other worker, an end which will be difficult to attain unless industry is prepared to guarantee the same conditions of permanency to craftsmen as it does to clerks and others of the administrative staffs

Papers read and discussed during the meetings included "Broadcasting and its Relation to Further Education," by Mr C A Siepmann, of the B B C "Industrial Safety," by Sir Gerald Bellhouse, H.M Chief Inspector of Factories, and "Technical Training for Women," by Miss E E Cox, of the L C C Barrett Street Trade School

In connexion with the paper on industrial safety, a visit was arranged to the Home Office Industrial Museum, where safety devices are set out in admirable fashion Few people, as Sir Gerald Bellhouse pointed out in his paper, realise how big a toll accidents make upon industry Yet the most recent figures show that 156,974 accidents (of which 973 were fatal) were reported during 1927 to the Factory Department Out of these cases, those which come within the Factory and Workshop Acts mean that each year about £2,500,000 is paid in compensation additional administrative, legal and medical costs must bring the figure to not less than £5,000,000 per annum Statistics such as these should in themselves be sufficient to make employers, employees, staffs, and students of engineering schools in universities and technical colleges desire to visit the Home Office Industrial Museum, where may be seen all the best methods of preventing danger to life and limb which have become incidental to industrial processes

University and Educational Intelligence

CAMBRIDGE —Mr E N Willmer has been appointed University lecturer in physiology

The following grants have been made from the Balfour Fund £100 to Dr C M Yonge, for researches at Honolulu and elsewhere in reference to his experiments on the Great Barrier Reef, £50 to Mr F S Russell, for researches on the plankton of the Great Barrier Reef region

Birbal Sahni, Emmanuel College, has been approved for the degree of doctor of science

LEEDS —Mr F J Dent has been appointed gas research chemist in the Department of Coal Gas and Fuel Industries in succession to Dr A Parker, who has resigned in order to take up a responsible post with the Water Pollution Section of the Department of Scientific and Industrial Research Mr Dent has been working in the Department under Prof J W Cobb for the past two years upon the gasification of special cokes in oxygen, and upon heat treatment in hydrocarbon and other gases as a factor influencing the reactivity of coke

London —An offer by the trustees of the late Mr C H Clark of a sum of £10,000 for the establishment of a lectureship in the history and progress of preventive medicine and tropical hygiene has been accepted The Prime Minister has forwarded a grant of £1000 from the Beaverbrook Fund for Medical Research, to be applied to the purposes of, and administered under, the scheme for the Thomas Smythe Hughes Medical Research Fund

Dr T G Hill, reader in plant physiology at University College has been appointed to the University chair of plant physiology, tenable at University College, as from Aug 1 next He is the author (with Dr P Haas) of "An Introduction to the Chemistry of Plant Products" (1913), and of numerous papers on the structure and development of the higher plants, oxidative processes, etc, in botanical and other journals

Dr E J Salisbury, reader in plant ecology, has been appointed to the Quain chair of botany, tenable at University College, as from Aug 1 next His recent publications include papers on the influence of earth worms on soil reaction, geographical distribution of plants, and the causes and ecological significance of stomatal frequency

Prof W E Le Gros Clark, professor of anatomy at St Bartholomew's Hospital Medical College, has been appointed as from Sept 1 next to the University chair of anatomy tenable at St Thomas's Hospital Medical School

Sir John Dewrance, Prof W T Gordon, Dame Helen Gwynne Vaughan, and Sir John Snell are among the recently appointed fellows of King's College

Oxford —All Oxford men who have worked in the University Museum will be gratified that the degree of M A *honoris causa* has been conferred on Alfred Robinson, assistant to the secretary to the curators, and a well known figure to all science students in Oxford for the last fifty years

At a forthcoming meeting of Congregation, decrees will be proposed expressing the gratitude of the University (1) for the gift, received through the Prime Minister, of £1000 from Lord Beaverbrook for the furtherance of medical knowledge, and (2) for the bequest by the late Prof A W Scott of £4322 to be applied for the furtherance of physical science

Sheffield —Applications are invited for an Ironmongers' Company Research fellowship, value £500, and for two Ironmongers' Company Research Scholarships, each of the value of £150, particulars of which can be obtained from the Registrar, The University, Sheffield The latest date for the receipt of applications is April 1

Wales —Applications are invited from graduates of the University of Wales for five fellowships, each of the annual value of £200 and tenable for two years The applications must be received not later than June 1, by the Registrar, University Registry, Cathays Park, Cardiff

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The New York correspondent of the *Times* has announced three important gifts for education in the United States North Western University is to receive about £1,600,000 under the will of Mr Milton H Wilson, New York University has received an unrestricted endowment of £200,000 from Mr and Mrs Percy S Straus, and Newhaven Hospital, which is affiliated to the Yale School of Medicine, has received £400,000 from the General Education Board of New York City, to be devoted to a new laboratory and dispensary and a service unit

Calendar of Patent Records

March 4, 1633 —On Mar 4, 1633, Richard Delamain petitioned Charles I that, in accordance with a promise given by the king two years earlier, he might have the sole making of a "mathematical instrument extracted from the logarithms and projected in circles for the speedy operating of mathematical practices" The petition passed the Signet Office on the same day, but no patent is enrolled, and it is uncertain whether this first patent for a slide rule was ever actually issued Delamain was not the first inventor of the slide rule The credit for this belongs to William Oughtred, who, according to his friend and translator, William Forster, had invented the instrument some years before and had not published the invention because ' it is a preposterous course of vulgar teachers to begin with instruments, and so instead of artists to make their scholars only doers of tricks and as it were juglers, to the despite of art, losse of precious time, and betraying of willing and industrious wits unto ignorance and idleness "

March 5, 1825 —On this date there was granted to W H James, one of the pioneers of railway transportation, a patent for a system of train propulsion in which all the axles throughout the train were driving axles, longitudinal shafts on the carriages operating the wheels through bevel gearing and being connected to each other by universal couplings the front shaft being driven by a steam engine or other agent An experimental line was laid down on which inclines of 1 in 12 were successfully negotiated, but the system was never adopted on the railways of Great Britain

March 6, 1648 —During the last few years of Charles I the ordinary machinery of granting patents broke down, and there are no entries in the printed indexes for the period 1642–49 The patent granted to Sir William Petty on Mar 6, 1848, for his invention of double and multiple writing, was issued by the authority of an ordinance of the "Lords and Commons assembled in Parliament," which formed the warrant to the Solicitor General and to the Commissioners of the Great Seal Petty seems to have had some difficulty in securing the adoption of the invention, for in the following year Parliament is petitioned by one Henry Morris to grant Petty and Morris "either a tax of *2d* a ream on paper, or *2s 2d* on 60 skins of parchment for a few years, or else £1500 or £2000 down for their services, or some good office"

March 6, 1916 —Rustless steel first attracted public attention when stainless table cutlery was introduced in 1914, though the importance of chrome and of nickel alloys had long been recognised The remarkable properties of high chromium iron were, however, not fully realised until the researches of Harry Brearley of Sheffield, which resulted in the production of a steel containing between 9 and 16 per cent chromium and not more than 0 7 per cent carbon, which was practically untarnishable and could be forged, rolled, hardened, and tempered, under commercial conditions Brearley's discovery was published before a British patent was applied for, but he obtained patents in Canada and the United States, the application in the latter country being filed on Mar 6, 1916

March 8, 1859 —A satisfactory cotton harvesting machine has yet to be discovered, and most of the world's cotton is still picked by hand, but of the many attempts to solve the problem, the pneumatic picker has had the greatest amount of success The first patent for a pneumatic harvester was granted in the United States to John Griffin on Mar 8, 1859, steam being employed to produce the vacuum

Societies and Academies

LONDON

Royal Society, Feb 21 —**P Kapitza** The change in electrical conductivity in strong electric fields (Parts 1 and 2) The change of resistance in a transverse field at temperatures of room, of solid carbon dioxide and ether, and of liquid nitrogen, has been studied in many metals It follows the same law in all of them The formula obtained gives a square law in weak fields and a linear law in stronger fields Change of resistance follows a linear law with increasing field, but in weak fields it is masked by disturbances existing in the metal equivalent to an internal magnetic field This additional resistance is independent of temperature, while the ideal resistance has a constant value for a given temperature for each metal, independent of its physical and chemical state The additional resistance is identical with the residual resistance which is observed at very low temperatures Supraconductivity is a general phenomenon in all metals, but is masked by additional resistance, which disappears at very low temperature in certain metals —**R R Nimmo** and **N Feather** An investigation of the ranges of the long range α particles from thorium C' and radium C, using an expansion chamber 'Extrapolated' ranges 9 90 and 11 70 cm in standard air were obtained for the long range α particles from thorium C in the ratio of 1 5 1 541 particles have been observed belonging to these groups In addition, 9 had ranges between 12 5 cm and 17 cm, and 13 had longer ranges The range of the most abundant group of long range α particles from radium C was measured as 9 16 cm, it is likely that there are others with ranges 8 1 cm 10 0 cm, and 11 0 cm respectively Nearly 500 long range particles from radium C were recorded —**C R Burch** Some experiments on vacuum distillation The method of evaporative distillation can be applied to the derivatives of petroleum An elementary kind of fractionation is possible Petroleum derivatives of exceedingly low vapour pressure can be prepared —**E C C Baly** and **N R Hood** The photosynthesis of naturally occurring compounds (4) —**B W Currie** and **R Alty** Adsorption at a water surface (1) —**W G Palmer** Some adsorption isothermals for a plane platinum surface —**B Lambert** and **A M Clark** Studies in gas solid equilibria —**G C Laurence** Relative velocities of the alpha particles emitted by certain radioactive elements —**H W Thomson** and **C N Hinshelwood** The mechanism of the homogeneous combination of hydrogen and oxygen —**E G Dymond** and **E E Watson** Electron scattering in helium —**E T Hanson** Diffraction and resonance —**S Goldstein** (*a*) The forces on a solid body moving through viscous fluid (*b*) The steady flow of viscous fluid past a fixed spherical obstacle at small Reynolds' numbers Oseen's equations for the flow of a viscous fluid at small Reynolds' numbers past a fixed spherical obstacle are solved completely, and a table given of the resulting values of the drag coefficient —**J Taylor** On the chemical interaction of ions, and the 'clean up' of gases at glass surfaces under the influence of the electrical discharge —**H M Macdonald** The total reflection of electric waves at the interface between two media —**L Hartshorn** and **D A Oliver** On the measurements of the dielectric constants of liquids, with a determination of the dielectric constant of benzene An accuracy of 1 in 10,000 is obtained, using a capacity method The method requires a comparatively large volume of liquid For very pure liquids in small quantities, a comparison method is used The dielectric constant of benzene is 2 2825 at 20° C, with a probable error of ± 2 parts in 10,000, mainly due to difficulties of obtaining a sample absolutely free from water —**J W Fisher** The wave equation in five dimensions —**E Griffiths** and **J H Awbery** Measurements of flame temperatures —**K Lonsdale** The structure of the benzene ring in $C_6(CH_3)_6$ The benzene ring in this compound is similar in shape and size to the six carbon ring in graphite, the nuclear carbons having a diameter of 1 42 A Three of the valencies of aromatic carbon are co planar, the ring itself and all the side chain carbon atoms lying in the (001) cleavage plane The puckered or 'diamond' type of benzene ring, and Morse's model are inadmissible

Geological Society, Feb 6 —**E St J Burton** The horizons of Bryozoa (Polyzoa) in the Upper Eocene beds of Hampshire Special horizons on which an abundance or deficiency of bryozoan remains occur are indicated within the three divisions of the Barton Beds (Lower, Middle, and Upper Barton) A recurrent facies of sedimentation may be coincident with the reappearance of species on higher horizons in the series —**M Black** The upper estuarine series of Yorkshire The Estuarine Series of Yorkshire is of deltaic rather than estuarine origin, and bears a close resemblance to the Coal Measures The Upper Estuarine Series is best exposed in the coast section between Gristhorpe and Cloughton (Yorkshire), where the sequence can be made out It is possible to distinguish between autochthonous plant beds and allochthonous, or drifted, ones The former are rare in the Upper Estuarine Series The drifted plant beds are much better developed Among these, a definite relationship exists between the type of sediment and the flora which it encloses The plant fragments seem to have behaved as a sediment transported by the water of the distributaries

Society of Public Analysts, Feb 6 —**T P Hilditch** and **Eveline E Jones** The fatty acids and component glycerides of some New Zealand butters The procedure consisted in oxidising the butter fat by means of permanganate under conditions in which all unsaturated components were transformed into acidic products, whilst glycerides containing only saturated fatty acids remained unaltered These fatty acids were recovered and their composition determined —**A Scott Dodd** A new test for boric acid and borates The pink coloration produced by adding mannitol and methyl red or sofnol indicator No 1 to a neutral solution is characteristic of boric acid, a distinct reaction being obtained with so little as 0 2 mgm The only substances causing any interference with the distinctness of the reaction are phosphates, arsenates, chromates, and tungstates, which make it difficult to ascertain the exact point of neutrality —**B E Dixon** The determination of small quantities of beryllium in rocks The chief obstacle to the accurate determination of small quantities of beryllium in silicate rocks is the difficulty of separating it from titanium This difficulty has been overcome by the use of *p* chloroaniline, which will precipitate titanium completely

DUBLIN

Royal Dublin Society, Jan 22 —**W R G Atkins** and **H H Poole** The photoelectric measurement of the illumination in buildings The vertical illumination was measured simultaneously in an exposed position and in the building The percentage ratio when the sun is obscured is called the 'daylight factor' A dwelling house and an old church were examined The illumination in the former was less than 1 per cent

in most places, rising to 7 per cent just inside large windows, or 14 per cent with the photometer sloped towards the light The factor in the church varied from 0 02 to 0 86 per cent, or, with sloped photometer, from 0 03 to 1 85 per cent It seems to be futile to use special glass, transparent to ultra violet light, in the usual type of dwelling house in windows which do not, at some time of the day, receive direct sunlight —**H H Poole** A modified form of radium emanation apparatus The apparatus in use in the Irish Radium Institute for pumping off emanation and drawing it into capillary tubes for therapeutic purposes has been modified so as to render its action more automatic, thus reducing the exposure of the operator to the radiations, and enabling the work to be carried on by a succession of less highly skilled workers than were required with the apparatus in its old form

Royal Irish Academy, Jan 28 —**P J Nolan** and **C O'Brolchain** Recombination of ions in atmospheric air (Part 1) Investigation of the decay coefficient by Schweidler's method The linear recombination law for small ions in atmospheric air is verified The recombination coefficient between small ions and nuclei is not constant The variation does not appear to be connected with the concentration of dust particles in the air —**P J Nolan** Recombination of ions in atmospheric air (Part 2) The law of recombination of ions and nuclei The relation between the rate of production of ions in atmospheric air and the equilibrium concentrations of small ions and nuclei is best represented by the equation $q = an^2 + \zeta n\sqrt{N}$ where $\zeta = 55 \times 10^{-6}$ The results of field observations generally support the proposed equation

EDINBURGH

Royal Society, Feb 4 —**N B Eales** The anatomy of a fœtal African elephant, *Elephas africanus* (*Loxodonta africana*) (Part 3) The contents of the thorax and abdomen, and the skeleton A detailed specification of the Proboscidea is given, anatomical differences between *Elephas* and *Loxodonta* are noted, and the relationships between the Proboscidea and other orders of mammals are discussed The group has numerous features of a primitive nature, in which it exhibits resemblances with the Rodentia, Sirenia, Hyracoidea and the Primates The nearest relatives were the ancestors of the modern Sirenians —**A D B Smith** and **J R Brown** Rôle of inbreeding in the development of the Jersey breed of cattle Inbreeding has played a small part in the construction of the breed in England Sewall Wright's coefficient now stands at only 3 9 + 0 3 as compared to the Clydesdale breed of horses with 6 and Shorthorn cattle with 26 Cows with annual lactations of more than 1000 gallons in less than a year are significantly less inbred, having a coefficient of only 1 85 Possible reasons are (1) miscellaneous inbreeding does not produce good results in yield, (2) heterosis between two strains, (3) inheritance of milk yield may not be in a common autosomal manner, but may be sex linked, in which case only certain types of inbreeding would be effective —**A W Greenwood** and **J S S Blyth** An experimental analysis of the plumage of the brown Leghorn fowl Whereas the plumage typical of the male is developed independently of the gonad and depends for its maintenance on a certain level of thyroid functioning, both gonad and thyroid play a part in regard to that of the female the former stimulates the latter to a higher level of activity than that present in the male and so indirectly causes a hyperthyroid effect on the feathers At the same time it modifies this condition by acting directly on the feathers and restricting the deposition of melanin into pencillings —**C W Stump** A human blastocyst *in situ* The blastocyst was obtained from the body of a woman aged forty six years It was fixed the day after the death of the mother, who was killed by a motor car accident, but was slightly injured Examination of the sections of the blastocyst and of the reconstructions made from the sections, place it in Bryce's group *D* of human blastocysts, which, now, with the addition of this new specimen, named H 381, and Stieve's Hugo specimen, includes thirteen blastocysts of relatively similar age

GENEVA

Society of Physics and Natural History, Dec 6 —**Rolin Wavre** The formula of Clairaut relative to geodesy The author obtains Clairaut's formula by a method much simpler than those hitherto given His calculation has the double advantage of not requiring the use of spherical functions and of making an approximation only at the last stage of the new and rigorous formulæ —**Pierre Dive** Internal movements of the terrestrial fluid The author applies the formulæ recently established by him, on the laws of rotation of a heterogeneous fluid with a density increasing with the depth, to the case of the earth Geophysicists admit that the continents should be considered as a light scoria floating on a denser viscous mass The calculations of M Dive give increases of velocity at a depth of 100 kilometres of 5 3, 7, 8 6, 9 5 cm per second for surface densities of 3, 2 6, 2 5, 2 4 respectively Of two continental masses floating in the viscous under layer, the larger and more deeply submerged will be carried towards the east with a greater velocity This movement is certainly much reduced by the viscosity, not taken into account in the calculations This calculation gives a concrete and simple explanation of the tangential force which geologists have long considered as the principal factor in the deformations of the solid part of the globe —**Adrien Jayet** The age of the lower portion of the sub lithographic limestones of the calcareous Alps of Haute Savoie The lower part of these limestones, styled Senonian in the explanation of the geological map of France (1/80,000), merge laterally into fossil bearing Cenomanian layers Hence there is not, at the point where the latter are missing in the series, an interruption in the series It is a matter of a lateral change of facies in a continuous sedimentary series

VIENNA

Academy of Sciences, Nov 16 —**J E Hibsch** The geological age of the sands and sandstones of the Bohemian Mittelgebirge, hitherto held to be Middle Oligocene —**K Menge** (1) A theorem on the length of an arc —(2) The general separation theorem

Nov 22 —**W J Müller** and **O Löwy** The theory of passivity phenomena (4) The dependence of the specific time of passivation for iron on the concentration and nature of the electrolyte —**R Dworzak** and **T Lasch** Cyclo acetals —**F Heritsch** *Michelinia Abichi* from the upper carboniferous of Nassfeld in the Carnic Alps —**D Poerner-Patzelt** and **A Pischinger** The behaviour of the structures of striated muscle fibres towards acids Muscles of various sorts were used in acetate–acetic acid buffers and with known hydrogen ion content and afterwards examined microscopically —**K Przibram** A colour change by pressure (piezochromy) in fluorite Green fluorite powdered and then compressed at 10,000 kgm per sq cm becomes violet —**L Kober** Mesozoic breccias in the upper schist cap of the Sonnblick and Glockner group

Official Publications Received

BRITISH

Canada. Department of Mines Mines Branch. Diatomite its Occurrence, Preparation and Uses By V L. Eardley Wilmot (No 691) Pp viii+182. (Ottawa F A. Acland.) 30 cents

The Journal of the Institution of Electrical Engineers Edited by P F Rowell. Vol 67 No 385, January Pp 125 216+xxxvi. (London E and F N Spon Ltd) 10s. 6d

The British Electrical and Allied Industries Research Association (incorporated). Eighth Annual Report October 1 1927 to September 30 1928. Pp. 71 (London)

The Scientific Proceedings of the Royal Dublin Society Vol 19 (N S) No. 14 On the Structure of *Palaeacis* By Dr Louis B Smyth Pp 125 138+plates 6-8 (Dublin Hodges, Figgis and Co. London Williams and Norgate Ltd) 2s

The Proceedings of the Physical Society Vol 41, Part 1 No 226 December 15 1928. Pp viii+112 (London) 7s net

City and County of Bristol The Bristol Museum and Art Gallery Report of the Museum and Art Gallery Committee for the Year ending 30th September 1928 Pp. 24+12 plates (Bristol)

Western Australia Annual Progress Report of the Geological Survey for the Year 1927 Pp 39+11 plates. (Perth Fred Wm Simpson)

The Why and Wherefore of Farming a Course for Elementary Schools in Rural Economy By Dr B A. Keen. Course 1 Broadcast from London and Daventry Fridays September 21st-December 14th (omitting October 26th), 2 30 2.55 p m Pp 32 1d. Course 2 Broadcast from London and Daventry Fridays, January 18th-March 15th 2 30-2 55 p.m Pp. 36. 1d. (London British Broadcasting Corporation)

Proceedings of the Royal Society of Edinburgh Session 1927-1928 Vol 48 Part 3, No 16 The Lattice Points of a Circle By Prof J R Wilton Pp. 191 200 (Edinburgh Robert Grant and Son London Williams and Norgate Ltd) 1s

Department of Scientific and Industrial Research Report for the Year 1927 28 (Cmd 3258) Pp v+217 (London H M Stationery Office) 4s net

Biological Reviews and Biological Proceedings of the Cambridge Philosophical Society Edited by H Munro Fox Vol. 4 No 1 January Pp. 102+7 plates (Cambridge At the University Press) 12s 6d. net

Proceedings of the Geologists Association Edited by A K Wells Vol 39 Part 4 January 21st. Pp 369 503+viii (London Edward Stanford Ltd) 5s

Rubber Research Institute of Malaya. Quarterly Journal Vol 1 Nos 1 and 2 January Pp 120 (Kuala Lumpur) 1 dollar

Journal of the Indian Institute of Science. Vol 11A, Part 14 Oil from the Seeds of *Adenanthera pavonina*—A Source of Lignoceric Acid By S M Mudbidri P Ramaswami Ayyar and H E Watson Pp. 173 180 (Bangalore) 8 annas

Southern Rhodesia Geological Survey Bulletin No 11 The Geology of the Country around the Lonely Mine Bubi District. By A M Macgregor Pp 96+7 plates. Short Report No 23 Interim Report on the Geology of the Chromite Deposits of the Umvukove Range Lomagundi District By F E Keep Pp 10+8 plates (Salisbury S Rhodesia)

FOREIGN

Bulletin of the Bingham Oceanographic Collection Peabody Museum of Natural History, Yale University Scientific Results of the First Oceanographic Expedition of the *Pawnee*, 1926 Vol 2 Art. 5 Mollusks from the Gulf of California and the Perlas Islands By Lee Boone Pp. 17+3 plates Vol 2 Art 6 Echinoderms from the Gulf of California and the Perlas Islands By Lee Boone Pp. 14+9 plates Scientific Results of the Third Oceanographic Expedition of the *Pawnee* 1927 Vol 3 Art 3 Deepsea Fishes of the Order Iniomi from the Waters around the Bahama and Bermuda Islands with Annotated Keys to the Sudidae Myctophidae Scopelarchidae Evermannellidae Omosudidae, Cetominidae and Rondeletidae of the World By Albert Eide Parr Pp 193 (New Haven Conn)

Koninklijk Nederlandsch Meteorologisch Instituut No 106a Ergebnisse aerologischer Beobachtungen 17, 1928 Pp ix+46 2 50 fl No 104a, Supplement Oceanographische en meteorologische Waarnemingen in den Indischen Oceaan December Januari, Februari (1856-1910). Tabellen Waarnemingen Noord van O (18.6-1923). Pp ix+36 1 25 fl No 108 Seismische Registrierungen in De Bilt 13 1925 Pp ix+52 1 00 fl (Utrecht Kemink en Zoon)

Journal of the Faculty of Agriculture Hokkaido Imperial University Sapporo, Japan Vol 23, Part 2 Chemical Studies on the Brewing Barley By Yukihiko Nakamura Pp. 29-86 (Tokyo Maruzen Co Ltd)

Scientific Papers of the Institute of Physical and Chemical Research Nos 168 169 On the Mode of Areal Distribution of Gliding Sparks on a Surface coated with Granular Conductor, by Ukitirô Nakaya On the Mechanism of Gliding Spark, by Torahiko Terada. Pp 237 264+plate 8 40 sen No 170 Physico-chemical Studies on Bioluminescence 6 The Mechanism of Luminescence in the Cypridina Luciferin and Luciferase Suggested By Sakyo Kanda Pp. 265 269 15 sen Supplement, Vol 9 No 7 A Trial to remove Hydrogen from Higher Fatty Acids By Tsuneo Suzuki and Torao Kurita Pp 5 8 10 sen (Tokyo Iwanami Shoten)

Japanese Journal of Physics Transactions and Abstracts. Vol 5 No 2 Pp. 67 101+15 24 (Tokyo National Research Council of Japan)

Berichte der Deutschen Chemischen Gesellschaft. Jahrgang 62, Nr 1 Pp vi+295 (Berlin Verlag Chemie G m b H)

U S. Department of Agriculture Farmers Bulletin No 1571 The European Starling in the United States. By E R Kalmbach Pp. ii+27 (Washington, D C Government Printing Office) 5 cents

Agricultural Experiment Station Michigan State College of Agriculture and Applied Science Special Bulletin No. 181 A Study of Town-Country Relationships By C R Hoffer Pp. 20 Special Bulletin No. 186 Chrysanthemum Breeding By Elmer D Smith and Alex Laurie Pp 30 Technical Bulletin No 94 A Study of Gelatins and their Effect on Ice Cream. By P S Lucas and E C Scott Pp. 24 (East Lansing, Mich)

Department of the Interior Bureau of Education. Bulletin, 1928 No 17 Bulletins of the Bureau of Education 1906-1927 with Index by Author Title and Subject By Edith A Wright and Mary S Phillips Pp ii+65 (Washington D C. Government Printing Office.) 10 cents

Proceedings of the United States National Museum Vol 74 Art 1 New Diptera or Two-winged Flies from South America By J M Aldrich (No 2746.) Pp 25 Vol 74 Art 9 Moniezia a Genus of Cestode Worms and the Proposed Reduction of its Species to Three By E. Leonard Taylor (No 2754) Pp 9+5 plates Vol 74, Art 20 A new Species of Trichostrongylid Worm of the Genus Cooperia from the Carabao in the Philippine Islands with a Review of the Genus By Benjamin Schwartz (No 2765) Pp 5+1 plate (Washington D C Government Printing Office)

Institut de France Académie des Sciences Annuaire pour 1929 Pp 386 (Paris Gauthier Villars et Cie)

Division of Fish and Game of California. Fish Bulletin No 12 The Weight Length Relationship of the California Sardine (*Sardina caerulea*) at San Pedro By Frances N Clark Pp. 59 Fish Bulletin No 13 Seasonal Average Length Trends at Monterey of the California Sardine (*Sardina caerulea*) By Carroll B Andrews Pp. 13 (Sacramento Calif California State Printing Office)

CATALOGUE

Catalogue of Scientific Books and Publications of Learned Societies (No 323) Pp 48 (Cambridge W Heffer and Sons Ltd)

Diary of Societies

FRIDAY MARCH 1

ROYAL SOCIETY OF MEDICINE (Otology Section) at 10 30 A.M —J S Fraser and E D D Davis Discussion on The Acute Ear Microtia and Atresia of the External Meatus

ROYAL SOCIETY OF MEDICINE (Laryngology Section) at 5

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group) at 7 —Informal Meeting

SOCIETY OF CHEMICAL INDUSTRY (*Manchester* Section) (at Engineers Club Manchester) at 7 —Prof T P Hilditch Recent Advances in our Knowledge of the Structure of the More Common Fats

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section) at 7 —W Lawson The Rotor Bearings of Electricity Meters

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Informal Meeting) (at Newcastle upon Tyne) at 7 15 —Sir Joseph Isherwood Bart. and others Do the Rules of Classification Societies tend to improve Shipbuilding and Engineering in this Country?

GEOLOGISTS ASSOCIATION (at University College), at 7 30 —S E Hollingworth Evolution of the Eden Drainage in the South and West —M Chatterjee The Accessory Minerals in the Bodmin Moor Granite

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7 30 —L S Atkinson The Control of Electric Lifts

INSTITUTION OF AUTOMOBILE ENGINEERS (Graduates Meeting) (at 51 West Regent Street Glasgow), at 8 —E C Philbrow Inspection

ROYAL SOCIETY OF MEDICINE (Anaesthetics Section) at 8 30 —Dr G M Slot Deaths under Anaesthetics with Special Reference to their Pathology

ROYAL INSTITUTION OF GREAT BRITAIN at 9 —Sir Robert Robertson Infra Red Spectra

ELECTROPLATERS AND DEPOSITORS TECHNICAL SOCIETY (Birmingham) Conference on Chromium Plating)

SATURDAY MARCH 2

ROYAL INSTITUTION OF GREAT BRITAIN, at 3 —Sir Ernest Rutherford Molecular Motions in Rarefied Gases (I).

MONDAY, MARCH 4

ROYAL SOCIETY EDINBURGH at 4 30 —Prof Hans Przibram Quanta in Biology

VICTORIA INSTITUTE (at Central Buildings Westminster) at 4 30 —Dr A R Short Recent Literature concerning the Origin of Species

ROYAL INSTITUTION OF GREAT BRITAIN at 5 —General Meeting

SOCIETY OF ENGINEERS (at Geological Society) at 6 —H R Lordly The Waterproofing of Concrete Structures

INSTITUTION OF AUTOMOBILE ENGINEERS (Western Centre) (at Merchant Venturers Technical College, Bristol) at 6.45 —A H R Fedden Air cooled Engine Repairs and Layout

INSTITUTION OF AUTOMOBILE ENGINEERS (Graduates Meeting) (at Loughborough College) at 7 —G I B Hall Lubrication

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7 —L J Hunt and others Discussion on Variable-Speed Alternating-Current Motors

INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (at Birmingham University), at 7 —Capt. J M Donaldson (Power Systems) J G Hines (Telephone Systems), and others Discussion on The Anticipation of Demand and the Economic Selection Provision and Layout of Plant.

HUNTERIAN SOCIETY OF LONDON at 7 30 —Prof A W Sheen Some Aspects of the Surgery of the Spleen (Hunterian Oration)

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8 —Dr L Hill Modern Methods of Heating and Ventilation

ROYAL SOCIETY OF ARTS, at 8.—Sir Thomas M Legge Thirty Years Experience of Industrial Maladies (Shaw Lectures) (III).

SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Chemical Society) at 8.—Prof A. R Ling Recent Advances in the Chemistry of Polysaccharides and Allied Compounds.

SURVEYORS INSTITUTION at 8.—F L. Thompson Recent Developments in Town Planning

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8 30.—Mrs. Gordon Gallien, J W Cornwall, and C C Rose The Kalambo River and Falls

TUESDAY, MARCH 5

ROYAL COLLEGE OF PHYSICIANS OF LONDON at 5—Dr J G Forbes Past and Present Diphtheria in England and Wales, with Special Reference to the London Metropolis (III)

ROYAL INSTITUTION OF GREAT BRITAIN, at 5 15—Prof. J S. Huxley Evolution and the Problem of Species (VI).

ZOOLOGICAL SOCIETY OF LONDON, at 5 30—B N Schwanwitsch Studies on the Wing pattern of *Catagramma* and Related Genera of South American Nymphalid Butterflies.—Dr R. Broom Note on the Milk Dentition of *Australopithecus*.—J W Low Contributions to the Development of the Pelvic Girdle III The Pelvic Girdle and its Related Musculature in Monotremes.—J S. Dunkerly A Note on Parasites and the Natural Selection Theory—S Hirst Additional Notes on Australian Mites of the Family Trombidiidæ with Descriptions of New Forms

INSTITUTION OF CIVIL ENGINEERS, at 6.—C Gribble Impact in Railway Bridges with Particular Reference to the Report of the Bridge Stress Committee

LONDON NATURAL HISTORY SOCIETY (at Winchester House), at 6 30—W H Spreadbury Common Birds of London a Country

INSTITUTION OF ELECTRICAL ENGINEERS (North Western Centre) (at Engineers Club Manchester), at 7—E B Wedmore Dr W B Whitney, and C E R Bruce An Introduction to Researches on Circuit Breaking

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group), at 7—W I Shand Pictorial Impressions in Italy

INSTITUTION OF AUTOMOBILE ENGINEERS (Graduates Meeting) (at Broad gate Cafe, Coventry), at 7 15—W S. Ascough Pistons

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Middlesbrough Branch) (at Cleveland Scientific and Technical Institution, Middlesbrough) at 7 30

INSTITUTION OF AUTOMOBILE ENGINEERS (at Royal Society of Arts), at 7 45—A E L Chorlton The Heavy Oil Engine on Road and Rail

ROYAL SOCIETY OF MEDICINE (Pathology Section) (Laboratory Meeting in Pathological Department, St Thomas's Hospital Medical School) at 8—J Bamforth Two Cases of Purpura with Unusual Blood Pictures for which Splenectomy was Performed—R. J V Pulvertaft Experiments with Streptococcal Toxin and Hæmolysins.—J O Oliver Group Complement Fixation with the Gram Negative Cocci

ROYAL SOCIETY OF MEDICINE (Orthopædics Section), at 8 30—Dr M Smith Petersen Sir Robert Jones and others Discussion on The Diagnosis and Treatment of Low Back Pain

TELEVISION SOCIETY—Annual General Meeting

WEDNESDAY MARCH 6

ROYAL SOCIETY OF MEDICINE (History of Medicine Section) at 5—Dr R. Campbell Thompson Assyrian Remedies for Diseases of the Ears

GEOLOGICAL SOCIETY OF LONDON at 5 30—Dr M M Ogilvie Gordon The Structure of the Western Dolomites (Lecture)

NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY (in Demonstration Room Science Museum) at 5 30—H O Clark A Comparison between French and English Windmills

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section) at 6—Capt. P P Eckersley and A B Howe Single Wave length Working

WOMEN'S ENGINEERING SOCIETY (at 41 Cadogan Square), at 8—Lady Bailey Flight round Africa.

UNIVERSITY OF GLASGOW ALCHEMISTS CLUB (at Glasgow University) at 7—Annual General Meeting

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (at Caxton Hall), at 7—Dr B J Owen The Desiccation of Vegetable Material

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (Annual General Meeting) (at Chemical Society) at 8—A. L. Andrew The Cryoscopic Method for the Detection of Added Water in Milk—Christina Mary Fear The Alkaloid Test for Tannin

ROYAL SOCIETY OF ARTS, at 8—T Purvis Commercial Art its Value in Business and Art

ENTOMOLOGICAL SOCIETY OF LONDON at 8

THURSDAY, MARCH 7

ROYAL SOCIETY at 4 30—Prof T M Lowry and A G Nasini The Molecular Dimensions of Organic Compounds Part I General Considerations—A G Nasini The Molecular Dimensions of Organic Compounds Parts II and III—Prof W A Bone and R P Frazer A Photographic Investigation of Flame Movements in Carbonic Oxide Oxygen Explosions—H S Patterson Prof R Whytlaw Gray and W Cawood Some Observations on the Condensation of Water on Smoke Particles The Process of Coagulation in Smokes, The Electrified Particles in Smokes The Structure of Complex Smoke Particles—*Papers to be read in title only*—J G Semple Cremona Transformations of Space of Four Dimensions by Means of Quadrics and the Reverse Transformations—T L. Ibbs and A. A Hirst The Thermal Conductivity of Gas Mixtures.—D M Newitt B J Byrne and H W Strong Equilibrium in the System Methyl Alcohol-Hydrogen-Carbonic Oxide—Prof W A Bone F R Weston and D A Winter Further Experiments on the Combustion of Well-dried Carbon Monoxide and Oxygen Mixtures Part III—Dr E K Rideal and O H Wansbrough-Jones An Investigation on the Combustion of Platinum—R. W Ditchburn and F L. Arnot The Ionisation of Potassium Vapour—Prof O W Richardson and P M Davidson The Spectrum of H_2 the Bands Analogous to the Parhelium Line Spectrum—R C Johnson and R. K Asundi A New Band System of Carbon Monoxide—Prof H. A Wilson The Theory of Cracking Petroleum—Prof T H Havelock The Dispersion of Double Refraction in Quartz—Prof A Fowler The Arc Spectrum of Silicon

ROYAL COLLEGE OF PHYSICIANS OF LONDON at 5—Prof E B Verney Polyuria (Goulstonian Lectures) (I)

ROYAL INSTITUTION OF GREAT BRITAIN at 5 15.—Rev W H Draper The Use of Language and its Difficulties

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6 30.—C N H Lock Airscrew Body Interference

SOCIETY OF CHEMICAL INDUSTRY (Bristol Section) (Annual Meeting) (at Bristol University), at 7 30—Chairman's Address

INSTITUTE OF METALS (London Local Section) (at 83 Pall Mall), at 7 30.—W T Griffiths 'Theory, 'Practice, and Nickel

INSTITUTION OF ELECTRICAL ENGINEERS (Irish Centre—Dublin) (at Trinity College, Dublin), at 7 45—E S. Ritter Picture Telegraphy (Lecture)

CHEMICAL SOCIETY, at 8.—F G Mann The Stability of Complex Metallic Salts.—A B Manning The Determination of Unsaturated and Aromatic Hydrocarbons in Light Oils and Motor Spirits—S. Glasstone Studies of Electrolytic Polarisation Part VII Complex Cyanides. (*a*) Silver Part VIII Complex Cyanides. (*b*) Copper

INSTITUTE OF CHEMISTRY (Manchester and District Section) (at Manchester)—Annual General Meeting

FRIDAY, MARCH 8

ANDERSONIAN CHEMICAL SOCIETY (at Royal Technical College, Glasgow) at 8 15—W H Nuttall Rubber and its Commercial Applications.

ROYAL SOCIETY OF ARTS (Indian Meeting), at 4.30—W H Moreland The Indian Peasant in History

ROYAL ASTRONOMICAL SOCIETY at 5—Prof S. Chapman Solar Streams of Corpuscles their Geometry Absorption of Light and Penetration—N Goryatscheff Occultations of Stars by the Moon observed at the Tomsk University Observatory during the Year 1928.—Prof S. Chapman and V C A Ferraro The Electrical State of Solar Streams.—Y Ohman Astronomical Consequences of the Polarisation of Fluorescence—W H. McCrea The Hydrogen Chromosphere—C L. Janssen Provisional Elements of the Binary System β G C 12807

IMPERIAL COLLEGE CHEMICAL SOCIETY (in Main Chemistry Lecture Theatre, Royal College of Science) at 5—Dr N V Sidgwick Chemical Linkage

PHYSICAL SOCIETY (at Imperial College of Science), at 5—Dr E Griffiths and J H Awbery The Dependence of the Mobility of Ions in Air on the Relative Humidity—Prof A M Tyndall Some Unsolved Problems relating to the Mobility of Gaseous Ions—followed by a General Discussion on the Mobility of Ions

ROYAL SOCIETY OF MEDICINE (Clinical Section), at 5 30

SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (Annual Meeting) (at Liverpool University), at 6—L. O Newton Boiler Feed Water

MALACOLOGICAL SOCIETY OF LONDON (in Zoological Department, University College) at 6

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN at 7—J A Hall Bromide Papers

JUNIOR INSTITUTION OF ENGINEERS at 7 30—S H Hole Road Transport (Chairman's Address)

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY (Jointly with Leicester Association of Engineers) (at Secular Hall Leicester), at 7 30—Dr J Newton Friend Science in Antiquity

INSTITUTE OF METALS (Sheffield Local Section) (at Sheffield University) at 7 30—D F Campbell and W S Gifford Progress in Electric Furnaces

OIL AND COLOUR CHEMISTS ASSOCIATION (Manchester Section) (at Milton Hall Manchester) at 7 30—S. T Kinsman The Fastness to Light of Lake Colours

ROYAL INSTITUTION OF GREAT BRITAIN at 9—Prof T F Tout The Place of Women in Later Medieval Civilisation

SATURDAY MARCH 9

ROYAL INSTITUTION OF GREAT BRITAIN at 3—Sir Ernest Rutherford Molecular Motions in Rarefied Gases (II).

PUBLIC LECTURES

FRIDAY, MARCH 1

UNIVERSITY COLLEGE, at 5—Dr F A Freeth The Four Component System in Peace and War

SATURDAY MARCH 2

HORNIMAN MUSEUM (Forest Hill) at 3 30—Prof J R Ainsworth Davis English Food Past and Present

MONDAY MARCH 4

KING'S COLLEGE OF HOUSEHOLD AND SOCIAL SCIENCE, at 4 45—Sir Alan Cobham Adventures in Empire Flight

LEEDS UNIVERSITY at 5 15—Prof D M S Watson Animal Flight.

UNIVERSITY COLLEGE HOSPITAL MEDICAL SCHOOL, at 5 30—Dr A M Ramsay The Eye in General Medicine (Succeeding Lectures on Mar 6 and 8)

EAST ANGLIAN INSTITUTE OF AGRICULTURE (Chelmsford), at 7—A W Street Recent Developments in the Marketing of Agricultural Produce

TUESDAY, MARCH 5

UNIVERSITY COLLEGE, at 5 30—Prof Karl Pearson The Heredity of Albinism illustrated by Recent Work on Albino Dogs and their Offspring

THURSDAY MARCH 7

UNIVERSITY COLLEGE at 5 15—Prof Hans Przibram Concerning Laws in Animal Morphology (Succeeding Lectures on Mar 11, 14, and 18.)—At 6—S. A Hill Willis Concrete Roads

40 TORRINGTON SQUARE, W C I, at 5 30—N B Jopson The Early Civilisation and Religion of the Slavs.

FRIDAY, MARCH 8

KING'S COLLEGE, at 5 30—C J Gadd Assyrian Studies in the Present and Future

SURVEYORS INSTITUTION at 5 30—Prof J S Huxley Heredity and Society (delivered in connexion with the Institution of Professional Civil Servants)

SATURDAY MARCH 9

HORNIMAN MUSEUM (Forest Hill), at 3.30.—R. W Sloley The Cave Artists of the Stone Age

SATURDAY, MARCH 9, 1929

CONTENTS.

Land and Industry

THE very heavy imports of foodstuffs into Great Britain and the urgent need for increasing the home production of food have been emphasised with wearisome iteration these many years past. A study of the trade returns for 1928 shows clearly enough that the position in this respect is getting worse. But our dependence on other countries to save us from starvation is only one part of the story. There are many other collateral factors of vital consequence. For example, it is not well that nine-tenths of our population should be entirely urban, completely exiled from the land, and wholly bereft of any land interest whatever. We may not all agree with what Mr. Galsworthy says about 'town blight,' but no one who has seriously thought about the matter, no one who has any appreciation of the teaching of history, can doubt that this entire exclusion from the land and all that it means is a potent source of national weakness, or at least of national one-sidedness.

Then, again, there is the vitally important question of leisure and its proper use. This has been hitherto a little neglected by economists, and yet, with the comparatively short hours of work now in vogue, it is a matter of the utmost moral and economic significance: the more so, in view of the increasing monotony of the greater part of the factory and office work of to-day, and mainly carried on indoors. These considerations point to the supreme need for a more natural and outdoor form of recreative work, such as would be provided by a land interest, as a powerful antidote to the present indoor monotony of work and the general artificiality of town life. The national love of outdoor sport, if sufficient facilities could be provided for its adequate expression and exercise, may be thought sufficient mitigation. But always there are more spectators than players, and we believe that there are many of both sexes and of all ages to whom some kind of land interest would make a more powerful appeal, and would certainly prove more useful and economically stronger. It is a pity that the allotment movement of the War period has not been more vigorously continued and extended since. It was a great deal better than nothing, though far from being the best thing of its kind that could be provided. The national housing programme offered the opportunity for something vastly better. That opportunity has been missed so far.

In fact, despite the very obvious and rather

disconcerting factors in our modern industrial civilisation noted above, very little has been done, at all events in Great Britain, where it is perhaps more urgently needed than in any other country, to counteract what must be described, without exaggeration, as a serious social evil We have had, it is true, much talk of 'back to the land,' really a fatuous and useless shibboleth in England, many acres of small holding legislation, for the most part derelict and only applicable to a small minority, and endless discussion of agricultural policies leading to little or nothing

We shall never be a nation of peasant proprietors despite the panegyrics of Mill, Sismondi, and others on that very admirable ideal, and therefore it might be advisable to look for something else, less drastic and complete, but more practicable, let us hope The suggestion has been made not infrequently in recent years that a partial return to the land would be the best, a part time recreative interest rather than a whole time occupation It would be merely a modified and improved form of industry cum agriculture which largely characterised our economic structure in pre industrial days, when the Lancashire weavers had their little farms and the Sheffield cutlers were noted for their culture of flowers To day it is a prominent feature in the United States of America, in Canada and other British dominions overseas, in many parts of Europe, and is struggling to make some headway in Great Britain, where, as already intimated, it is more urgently needed than anywhere It means the provision of homes or homesteads worth the name, with gardens and perhaps even orchards and greenhouses, embodying not only the primeval need of shelter but also the still more primeval need of food

So far from being original and novel, this idea goes back to Babylonian times Within the mighty walls of that ancient city were sheltered fields and gardens to provide food in time of siege, and indeed at all times Some day the same imperative need may be ours, and we should make provision in time A great deal has already been done along these lines in other countries, especially in the United States, and to some extent on the Continent It is strange indeed that the need for this sort of thing has been more clearly realised in the United States, where there is no preponderating town population and no 80 per cent dependence on foreign food, but it has been adopted over there not so much from the point of view of food supply but rather as a refreshing counter current to modern artificiality and rush It is a profitable hobby too, healthy, and absorbingly interesting In the case of the smaller holdings of industrial workers, from a quarter acre to one or more acres in extent, it is possible to pay the greater part of the rent—or, better still, the mortgage interest and sinking fund—from the garden and orchard produce, or, what comes to the same thing, save equivalent expenditure on vegetables and fruit for the home This would appear to be a very sound financial basis on which to establish any housing policy, and there, too, is the right solution of the leisure or 'dopo lavoro' problem as it is called in Italy

Italy has taken up the 'dopo lavoro' (after-work) or leisure question with enthusiasm in conjunction with home food supply It came up before the International Labour Conference at Geneva in 1924, but was discussed in Italian labour and commercial journals long before that date In Germany the great firm of Krupps some years ago purchased estates and farms for the production of food for its employees, many of whom became the proud owners of small holdings It is scarcely necessary to point out here that no shrewder blow could be struck at communism and general labour unrest than such a policy as this The ownership of a little bit of one's own country is surely the safest guarantee for sound and sober citizenship and real patriotism, and gives a man something to do other than listening to street corner oratory Several firms in Germany and Austria have followed the example of Krupps The municipality of Vienna has based its extensive housing schemes largely on this principle of ownership and land settlement It seems, indeed, to be the only common sense principle on which to base any housing programme, except blocks of flats or tenements to replace slums, and possibly even this exception is not often valid The subject presents many and varied openings and ramifications It has an important bearing on unemployment, emigration, and land settlement

So far, only one form of combining industry and agriculture, farm and factory, has been considered There is not space to deal with the converse form, that of giving the agricultural worker an industrial or rather a manufacturing interest, in the form of village and cottage industries and handicrafts This is another chapter, and is a well known economic feature in India, also in Switzerland, Norway, and elsewhere It is being taken up in Canada, for example, in Quebec, where the need for some occupation in bad weather and during the dark days of winter is very evident In these and other ways a people may be made to work harder

without knowing it, or, knowing it, they enjoy it It is doubtful if, in the sterner, strenuous, and fiercely competitive days ahead—if they have not already arrived—we can much longer afford to neglect this vital matter of using even our leisure to the best purpose At least greater opportunity for such could be afforded, and is within the range of practical politics

The question of leisure occupation for those already in work, important as it is, almost fades into insignificance, however, beside the greater question of unemployment So far as the programmes of the chief political parties have been revealed in view of the coming election, there does not appear to be anything refreshingly original or practically effective in contemplation to deal with this great evil, and it is not, of course, pretended in this article that the suggestions herein tentatively offered contain anything very helpful by way of remedy or mitigation It is, however, firmly believed that a vast field of employment could be opened up along the lines of land settlement, land reclamation, village industries, combined with industrial enterprise, possibly a programme somewhat similar to that adopted for the Greek refugees

It is not possible here to go fully into this part of the subject, except to say that the land interest—allotment, small holding, or the like—could be more effectively provided in garden cities, industrial villages, and so forth, where new industries could be established, than in or near existing industrial centres where little or no land is available In any event, the new derating concessions should be a great help in establishing industrial small holdings, and the extent to which such holdings are already used by those engaged in other occupations is revealed by a recent study of small holding economics in one county alone, for example, Carmarthen Nearly fifty per cent of all holdings under fifty acres are occupied by persons with non agricultural employments, representing nearly every trade and profession, miners, general labourers, carpenters, butchers, and grocers being the chief We are glad to know in this connexion that in some districts in South Wales, where allotments have gone out of cultivation on account of inability to pay rent for them, or purchase seeds or manures, the Society of Friends is successfully reviving allotment holdings and providing facilities for unemployed miners to work them for the production of food There could be no better use for grants from the Central Coalfields Distress Fund, in suitable districts, than to encourage work on the land in this way

Reform of the British Patent System

IT is clear from statements which have been made in the House of Commons during the past few months that a serious state of affairs exists at the Patent Office On July 18, 1928, Mr Herbert Williams stated, in answer to a question, that 6300 complete specifications were awaiting first action by the examiner and that these arrears were accumulating at the rate of 67 per week On Feb 26 last, in answer to a further question, he stated that the arrears now amounted to 8400 complete specifications and were increasing at the rate of 76 per week Since about 20,000 complete specifications are filed annually, the work is therefore just over five months in arrear on the average

Figures given by Mr Williams in July indicate that while the number of specifications to be dealt with annually had increased by 26 per cent as compared with 1912, the strength of the examining staff had decreased by 10 per cent This economy, at a time when the Patent Office obtains a large and increasing surplus of fees over expenditure, appears to be most unjustifiable The present critical state of affairs could have been foreseen and provided against some years ago, for the input of patent applications has been steadily increasing since patent business became normal after the War The public has a right to know why such steps were not taken in good time Did the Comptroller of the Patent Office fail to warn the Minister or did the Minister fail to heed his warnings ? Or is it that, as in the case of certain other technical departments, there is interposed between the Minister and the technical chief a body of administrative officials who fail to appreciate technical requirements ?

Last October an important report on the reforms which are needed in the British patent system was published by the British Science Guild This report met with an enthusiastic reception from the financial, technical, and daily press, and we understand that it has received the formal support of a number of important bodies Asked whether the Board of Trade proposed to take any action in this connexion, Mr Herbert Williams stated on Feb 26 that the President of the Board proposed to set up a committee in due course to review existing patent law and practice

While the British Science Guild Committee may be congratulated on this promise of a result arising from its labours, some disappointment will be felt at the absence of any indication that the matter will be carried through expeditiously

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications]*

Soft X-Rays from Crystal Faces

THESE experiments originated in an attempt to improve and extend those of Richardson and Chalklin on the generation of soft X rays from surfaces of tungsten formed by deposition *in vacuo* on carbon (*Proc Roy Soc*, A, **119**, p 71, 1928) In that investigation difficulties were met with owing to the deposition of impurities on the carbon target by the bombarding process necessary to secure the requisite high vacuum To avoid this difficulty we made a target like two doors folded together on a hinge We could bombard this target with the doors shut, and then open it out and so make the X ray tests on the inner surface which had been heated but not exposed to the residual gases in the tube

The tests are made by measuring the photoelectric current generated by the soft X rays when they fall on a nickel plate, dividing this by the primary thermionic current, plotting the fraction so obtained against the exciting voltage and looking for discontinuous changes of slope in the resulting curves On making this experiment we were surprised to find a large number of discontinuities extending all over the range from 20 to 560 volts These discontinuities are mostly well defined and quite persistent, and they repeated with a second target made from a specimen of spectroscopically pure arc carbon kindly supplied to us by Dr R C Johnson In this case the carbon was so soft that the hinge could not be made, and the surface of the target was protected during bombardment by a sliding shutter made from the same carbon

In the hope of simplifying the problem, we decided to try experiments in which the X rays were generated by bombarding a single crystal face of crystalline carbon Through the kindness of Prof W T Gordon we were able to obtain a diamond with a large natural face and some large pieces of natural crystalline graphite Unfortunately, the diamond was found to be unsuitable for the experiment, as an attempt to determine its electrical resistance showed it to be immeasurably high This would suggest that little confidence can be placed in the results of Lukirsky (*Zeits fur Physik*, **22** p 351, 1924) which were made with this substance A repetition of his experiments with the substitution of graphite carbon for diamond in this laboratory by Miss L P Davies led only to data which were very difficult to interpret, and, furthermore his results are incapable of reconciliation with the very reliable conclusions of Rudberg (*Proc Roy Soc*, A, **120**, p 385 1928)

After some trials we were able to split off a piece of graphite with a surface large enough to be suitable for testing The surface used was that at which natural graphite cleaves most easily (the 0001 plane) On testing the graphite surface between about 70 and 320 volts seventeen discontinuities have been found, each of which either agrees with a value or with the mean of two values a few volts apart, found previously with carbon Fifteen discontinuities which were present in this range with the carbon target are absent with the graphite target It should be added that the surface used was by no means perfect, so that it is possible that a still further reduction in the number of discontinuities might be effected if a more perfect surface could be obtained From these experiments there seems no doubt that the number of discontinuities from a single crystal surface is smaller than from a polycrystalline surface It is satisfactory to note that the *K* level discontinuity is not one of those which disappears

We should be grateful to any readers of NATURE who could supply us with any specimens of conducting crystals suitable for these experiments The materials must be capable of withstanding a bright red heat *in vacuo*

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U ANDREWES

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Soft X-Rays from a Single Nickel Crystal

AT the suggestion of Prof O W Richardson, an investigation was made on the excitation of soft X rays from a single crystal of nickel, kindly lent by Dr H H Potter, of the University of Bristol The face chosen was the [100] face and the range of potential was from 0 to 300 volts The experiment was conducted with an all quartz tube similar to the one used by Richardson and Chalklin (*Proc Roy Soc*, A, **110**, p 247, 1926) Curves were drawn between the applied potential and the energy of the soft X ray excited as measured by the usual photoelectric method When the bombarding current was maintained at about 1 5 milliamperes definite and strong inflections appeared at 63 8 72 2, 106 2, and 116 0 volts A very weak inflection was also noted at 94 4 volts No other inflections were obtained If, however, the thermionic current was increased to about 3 milliamperes, there appeared also, besides the four strong ones noted above, weak inflections at 129 0, 144 8 155 9, 179 9, 186 0, and 217 7 volts (all of which appear in the results of Thomas for nickel), while the inflection at 94 4 volts became stronger

As could be seen from the published microphotograph of the surface of a nickel crystal by Davisson and Germer (*Phy Rev*, II **30**, p 710, 1927), it is very difficult to obtain an ideally crystalline surface over an area of as much as 12 mm × 6 mm (the area used in these experiments), and there are bound to be some irregularities on the surface It looks, therefore, very probable that when an ideal crystal surface is used only four inflections appear, these being at 63 8, 72 2 106 2, and 116 0 volts The first two can be associated with transitions from the $M_{II\ III}$ level in the nickel atom, 63 8 volts representing the energy necessary to shift an electron from that level to the periphery of the atom and 72 2 representing the energy necessary to remove the electron altogether from the atom The emission data of Thoraeus (*Phil Mag*, vii **2** 2, p 1007, 1926) gives for the $M_{II\ III}$ level the value of 73 2 volts In the same manner the values 106 2 and 116 0 volts may be associated with similar transitions from the M_I level, the energy of which is 112 4 volts according to the same authority

It is well known that when a metal target (non crystalline) is heated strongly by electronic bombardment, the surface looks altered, probably because of the formation of small metallic crystals These crystals may in some manner be the origin of the large number of inflections observed by recent investigators Further, it would be interesting to determine the effect of a crystal surface on the secondary emission of electrons, since Prof Richardson has shown that there is a close similarity between the excitation of soft X rays and the emission of secondary electrons (*Proc Roy Soc*, A, **119**, p 531, 1928) Farnsworth (*Phy Rev*, II **31**, p 419, 1928) has

already reported that the characteristic secondary electron emission inflections from a crystal surface are different from those of ordinary metals between 0 and 40 volts It is proposed to repeat the soft X ray experiments with other crystals, as also to investigate the secondary electron emission from crystals further at higher potentials My sincere thanks are due to Prof Richardson for his kind help and encouragement, and to Dr H H Potter for the crystal of nickel

S RAMACHANDRA RAO

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Jan 29

Incoherent Scattering

THERE are several surprising peculiarities of the phenomena of modification of wave length in scattering, but the most striking is the rareness with which one is able to find an infra red line to fit even approximately the frequency shifts observed On the other hand, there are many strong infra red lines which have no corresponding frequency shift Moreover there is scarcely any direct correlation of intensity even when there is a supposed match in frequency

The idea suggested by Smekal that a molecule may subtract from or add to an incident quantum one of its characteristic energy quanta and scatter the resultant sum or difference in a single quantum is so neat and clear that it is accepted as the explanation of the scattering experiments of Raman and Krishnan and others The most important characteristics of such a process are those just indicated which are not realised in the experiments

Kramer's and Heisenberg's correspondence principle treatment is much more successful in accounting for the facts, and Schrödinger's wave mechanics gives an almost identical result, formally, which is on closer inspection in even better accord with experiment The wave theory for the scattering of light of frequency ν by a system excited in two of its characteristic states—let us call them k and l—leads to terms incoherent with the incident radiation of frequencies $\nu_{kl} \pm \nu$ and with intensities proportional to the square of the quantities

$$A_{kn}A_{ln}\left[\frac{1}{\nu_{kn} \pm \nu} + \frac{1}{\nu_{ln} \mp \nu}\right](\nu_{kl} \pm \nu)^2$$

The upper signs or the lower signs are used throughout The A_{kn}, for example, is the matrix element $\int r\psi_k\psi_n dx$, which describes the intensity of the transition between states k and n, giving out radiation of

frequency $\nu_{kn} = \nu_k - \nu_n = \dfrac{E_k - E_n}{h}$

We see that the modified frequencies $\nu_{kl} \pm \nu$ differ from the incident ν, not by absorption frequencies (although these may also appear) but by differences between these That is to say, only when two allowed transitions (*i e* A_{kn} and A_{ln} different from zero) have a common level (n) is there any intensity in the scattered frequencies $\nu_{kl} \pm \nu = \pm(\nu_{kn} - \nu_{ln}) \pm \nu$

Examination of the data shows that the frequency shifts in scattered light can be interpreted in this way The case of carbon tetrachloride is not the most striking, but it is perhaps the simplest which has so far been tried Only two out of five frequency shifts coincide with known infra red lines These two correspond perhaps to the weakest shifted lines, while the infra red lines are the strongest The intensity formula indicates that the strongest frequency shifts should correspond to the frequency differences between the strongest fundamentals and the other fundamentals which end on the same level This rule suggested the energy diagram (Fig 1) It is believed to contain elements of reality, but should not be considered as a final and complete picture The numbers along the full vertical lines are wave numbers of the infra red lines due to transition indicated The numbers by the dotted lines are the differences between levels joined, and indicate frequency shifts to be expected in scattered light The one of 27 wave numbers would be too close to the exciting line to be observed The others were obtained from grating and prism plates, and are probably correct to a couple of wave numbers

The test of the theory is to compare the wave lengths calculated from this diagram with those observed The infra red data are from J Lecomte, "Le Spectre infrarouge," p 213, and the references there given The table gives the wave lengths which are directly connected with the frequency shifts All the other known lines are faint, and with one exception

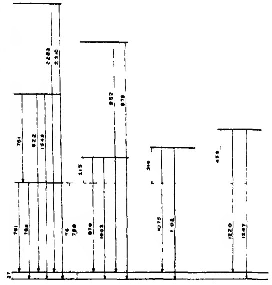

FIG 1

of much shorter and more uncertain wave length The exception is the weak line observed by Marvin at 15 μ Its interpretation is not yet definite The others are explicable as overtones or combinations of the levels shown In fact, just those combinations appear which, according to the wave theory, indicate the possibility of the modified lines actually observed

TABLE

Calc (μ)	13 14	12 69	10·24	9 97	9 10	9 07	8 20	8 0.	6 57	6 46
Obs (μ)	13 10	12 72	10 23	9 96	9 3	9 07	8 26	8 02	6 57	6 45

The agreement is in every case well within the experimental latitude The significance and power of the scattering experiments in unravelling infra red spectra is very much greater than if they merely checked infra red measurements With their help and with more precise infra red data it may be hoped that the vibrations of complex molecules will be interpreted A beginning will be made in a fuller account of this work

R M LANGER
(National Research Fellow)

Bureau of Standards,
Washington, D C,
Jan 4

Luminous Discharge in Gases at Low Pressure

Considering the very minute quantities of matter required for a luminous discharge in gases at low pressures excited by electric oscillations of high frequency, this method would seem to be specially adapted for spectroscopic tests for the products from atomic disintegration spontaneous as well as artificial. Experiments to this end were started some time ago in the Institut fur Radiumforschung of Vienna and have recently been carried further in this Institute. The following phenomena, which appear to be of general interest, were observed.

In order to make the discharge pass through narrower tubes and in gases of still lower pressure than what appears to have been feasible in the experiments of Kirchner, Gill and Donaldson, and others, oscillations of still higher frequency, 10^8 cycles per second, were applied to electrodeless discharge tubes made from transparent silica. Oscillations of this frequency and of considerabble energy, 45 watts or more, can now easily be realised by means of commercial short wave transmission valves. A luminous discharge was found to pass through tubes only 5 mm wide, and it could be maintained even at the lowest pressure realised by means of a powerful molecular pump backed by an oil pump of the Zenco type. The pressure was then much too low to be measured on the Gaede high vacuum gauge, reading to 10^{-5} mm of mercury and communicating with the discharge tube through a mercury trap cooled with liquid air.

At the lowest pressure the luminosity from the gas itself within the discharge tube was very faint and bluish in colour, whereas the silica showed a strong fluorescence in blue or in blue green. A few silica tubes gave a brilliant fluorescence in red which does not seem to have been observed before. Thermo luminescence and after glow of the silica were also manifest. An ultra violet component of the latter may be assumed to give the initial ionisation required for starting the discharge after a brief interruption of the electric oscillations. Restarting the oscillations after a longer pause, the tube, when highly exhausted, generally fails to light up until ultra violet light from, say, a cadmium spark, is allowed to fall on it.

On passing the discharge through the exhausted tube when disconnected from the pump, a curious phenomenon was observed. The luminosity rapidly increases, and from a faint blue glow takes on a white hue of increasing brightness, the manometer at the same time showing a considerable rise in pressure. Adsorbed gases cannot be held responsible for the effect, which remains unabated when the pump has been running for several hours, and is also unaffected by baking out the discharge tube for more than an hour at 600° C in an electric furnace. The production of gas goes on at a rate of about 1 c mm N T P per minute at very low pressure, and is noticeable even after the pressure has increased to several hundredths of a millimetre of mercury.

The only possible explanation of this phenomenon seems to be that silica is decomposed, releasing oxygen, under the action of the electric oscillations, or rather by ultra violet light of very short wave length generated at the discharge. Whether the active rays are the strong emission lines of oxygen itself in the far Lyman region will have to be settled by means of a vacuum spectrograph. Light transmissible through silica seems to be ineffective, since no sensible rise of pressure was noticed when the exhausted discharge tube with the oscillations off was exposed for more than one hour to the intense light from a quartz mercury lamp close to it.

The above explanation is in agreement with the results from recent observations by Gillam and Morton (*Phil Mag*, p 1123, December 1928), who found the general decrease with age in the emission from quartz mercury lamps to be due to a deposit of silicon over the inside of the walls, caused by decomposition of the silica. Anyhow, my experiments prove that the presence of mercury vapour is not essential for the effect. Also, judging from the relative magnitude of the effect in both cases, one would infer that the light from the oscillating discharge is much richer in active components than the mercury light.

The light emitted from the self-generated gas was examined in the visible region by spectroscope and spectrograph, and also, in the ultra violet, by a medium sized quartz spectrograph, the plates showing that its spectrum is rich in strong bands, especially in the ultra violet. Oxygen, from permanganate of potassium, when introduced into the discharge tube, gave a different light of yellow colour with a different and much fainter band spectrum which, however, very soon merged into that of the self generated gas and took on its white colour. The explanation was found by applying a tuft of cotton wool soaked in liquid air to the tip of the discharge tube, when the white light disappeared and was replaced by the yellow oxygen light, the manometer showing a progressive fall of pressure. On removing the liquid air the beautiful snow white light reappeared and the pressure rose, but only by about two thirds of the previous reduction. This proves that the oxygen, under the action of the oscillations, is more or less completely transformed into ozone, which gas is condensed at − 190°, the vapour pressure being at that temperature only a few thousandths of a millimetre of mercury. The spectrum from the white light of the self generated gas, which is identical with that from the ozonised oxygen, must therefore represent the band spectrum of ozone with a few sharp lines from elementary oxygen superimposed. By means of a larger quartz spectrograph this band spectrum has now been resolved into characteristic groups of lines, which are at present being examined. The fluorescent and chemical effects of the 'active' radiation assumed to exist within the discharge tube will be further studied.

This method of excitation seems to be particularly adapted for the study of band spectra, whereas for the purpose mentioned at the beginning of this letter, the steady production of oxygen within the discharge tube remains a serious complication. Possibly this effect may be a contributory cause of the softening of deep-therapy Röntgen tubes and of transmission valves.

Hans Pettersson

Lunds Fysiska Institution,
January

Solutions and Heat Engines

In Dr Holmyard's informed and charming review, under the title "The Theory of Atoms," in Nature of Feb 16, the statement is made that Hellas bequeathed to civilisation the priceless gift of logical deduction but lacked the spirit of modern science. "Everything," said Thales, "is full of gods."

The motive power of modern experimental science, without doubt, is a certain spirit but so highly diluted that it is not easily discerned: the atmosphere is so befogged with gods. The jesuitical notice, following Dr Holmyard's, by an anonymous reviewer of Dr Haldane's book on "Gases and Liquids," is an exemplification of this thesis. A certain school has long elected to worship van't Hoff—nothing that is said will lead its members to examine the premises of their deity's osmotic doctrine (hypothesis). Being

disputed, it cannot be called a theory The reviewer altogether disregards Dr Haldane's contention that the solvent has been neglected and only the solute considered Van't Hoff never thought in terms of water his was a purely thermodynamic mind The hypothesis *is* inherently unintelligible The late Prof FitzGerald said so long ago There is no proof of bombardment by the solute molecules, the tendency is more and more to admit that the solute molecules, whatever their form, are anchored to the solvent scarcely a preparation for ballistic exercise Whence does the bombardment come in the Perrin experiment, in which only water and very minute resinous particles are in interaction ?

Worship is part of our nature a faith once imposed is all but fixed we scarcely ever ask ourselves whether the gods held up to us be false or not Hellas may have bequeathed to us the gift of logical deduction—it in no way follows that we have learnt to use the gift However much of so called science there may be in us, it is rarely in us to be scientific The main difficulty in dealing with problems of solutions comes from the tendency to take mathematical expressions too seriously and absolutely and greatly to overrate their value to treat them as if they had a sacred meaning rather than as devices for wrapping up and obscuring meaning We need to get rid of gods and to put more of the holy ghost into our musings, so that they be made with method I agree with Dr Haldane that in this matter of osmotic pressure we have but "engaged in idolatrous worship of un understood equations" In any case, the discussion of such problems should be open, not anonymous anonymous attack should not be permissible in our society HENRY E ARMSTRONG

MAY I inquire from Prof Armstrong whether it is jesuitical to ask Dr Haldane to consider what the effect of the bombardment of the solute molecules will be even if I hope that his answer may, after all, be favourable to van't Hoff ? Moreover, as Prof Armstrong wishes to enter the arena, may I ask him also to consider the same question ? That there is bombardment is not a subject for question unless we are prepared to give up the dynamical theory of matter Prof Armstrong asks, somewhat sceptically, whence the bombardment comes in the Perrin experiment Surely what Perrin achieved was to show *visibly* that the dynamical theory is true The particles *are* in rapid motion, and are frequently colliding and each collision produces its expected dynamical effect That there is bombardment is not merely a happy hypothesis, it is an observed fact It cannot be explained away by the assertion that it is 'unintelligible'

Prof Armstrong, however, in spite of the evidence of his senses—for I presume he has seen Brownian motion, though perhaps he has not himself experimented with it quantitatively—wishes to ignore its effect, and suggests instead that the solute molecules are anchored to the solvent I challenge him to show how a pressure can arise from such attachments He must bear in mind that when there is equilibrium between the liquids on the two sides of an osmotic membrane, the solution is at a higher *external* pressure (that is the fact which is directly observed), and that attractions between molecules always act to reduce the *external* pressure

Physical chemists do not ignore the solvent It assists in certain cases to break up the solute molecules, and especially in strong solutions it has a great modifying influence, so that a simple 'gas' calculation is quite insufficient We need not be surprised at this, because similar modifications are produced in gases at high pressure

Prof Armstrong holds strong beliefs on these questions I urge him to put them into logical form so that others may be led into the right path Those of us who have read his papers find no rational theory there from which osmotic pressure can be calculated He must remember, however, that forces do not arise out of nothing like gods of ancient mythology Let him not be afraid of an equation which, after all, is only a somewhat condensed form in which the quantitative results of our thinking can be expressed It, of course, need not be 'idolatrously worshipped', and indeed, it may be dispensed with, though the alternative methods of description are not so compendious Above all, let him learn that assertion, even when strong is no adequate substitute for proof

Again I ask Prof Armstrong to join Dr Haldane and consider the question as to what the effect of the known bombardment of the solute molecules will be when a semi permeable membrane is provided through which the solvent can flow if it is induced to do so THE REVIEWER

Diffuse Bands and Predissociation of Iodine Monochloride

THE absorption spectrum of iodine monochloride consists of a group of bands (group Cl*) with an upper convergence limit at about 17430 cm $^{-1}$ corresponding to the dissociation of ICl into a normal iodine atom and a chlorine atom in the 2^2P_1 state There is also another group (group I*) of which only two members (17446 cm $^{-1}$ and 17570 cm $^{-1}$) were observed by Gibson and Ramsperger Several further members of this group have since been observed (Gibson unpublished measurements) These are visible in the region between the convergence and the absorption maximum of the continuum of group Cl*

We have strong evidence that the convergence limit of group I* corresponds to dissociation of iodine monochloride into normal chlorine and excited iodine atoms A second continuum farther in the ultra violet has also been observed and probably corresponds to this same process The band 17446 cm $^{-1}$ of group I* shows the fine structure clearly The rotation lines are sharp near the head, but show a marked increase in width for large rotational quantum numbers The next following bands of this group are diffuse and fade out in the region of continuous absorption of group Cl* It seems very likely that this effect is of the same nature as that discovered by Henri and termed predissociation The place at which the widening of the rotation lines begins in the band 17446 cm $^{-1}$ corresponds within experimental error to the convergence limit of group Cl* This suggests strongly that interaction between the Cl* continuum and the discrete states of group I* is responsible for the diffuseness

A similar assumption has been made by Wentzel to account for the diffuseness of the lines corresponding to the higher terms of the p' series of Ca, and by Bonhoffer and Farkas and by Kronig to account for diffuse band spectra Kronig has shown that under favourable conditions the life period of a discrete state may be so shortened by the presence of a continuum that it becomes less than the period of rotation, in which case diffuseness may be expected Calculations were made by us using perturbations of the type considered by Kronig, which arise from the terms in the wave equation neglected in the separation of electronic and nuclear co ordinates (see *Z Physik*, 50, 347, 1928) A formula has been obtained (to be published shortly by Rice) which permits a direct quantitative calculation of the width of the rotation lines when the perturbation matrices are known

Kronig arrives at two results for the perturbations according as the quantum number n which determines the angular momentum of the electrons about the nuclear axis changes by ± 1 or remains constant in the radiationless transition. In the first case the width of the rotation line varies with the square of the quantum number j, which determines the total angular momentum. In the second case the width of the line is independent of j. Kronig has made rough estimates of the orders of magnitude of the perturbations. Using his estimates we cannot account for the observed width of the lines of higher rotational quantum number unless we take the first case in which n changes by ± 1 and the width is therefore proportional to j^2. We have reason to believe, however, that n has the same value for group Cl* as for group I*.

It is possible, however, to account for the magnitude of the effect, even in this case, if we take into account the fact that the eigenfunctions are oscillating functions of the co-ordinates. We have made calculations, using Kronig's estimate for the electronic eigenfunctions and making very reasonable assumptions as to the nature of the vibrational eigenfunctions of the two states. The vibrational eigenfunctions are approximately sine curves. It is entirely consistent with what we know of the energy and moment of inertia of the molecule in its two states to suppose that the eigenfunctions have nearly the same wave length and such a phase relationship as to produce a large effect. The calculations show that perturbations of the type considered by Kronig are then sufficient to account for the observed widths. The effect would be still further enhanced if the electronic eigenfunctions of the two states should coincide in a similar manner, in which case a less complete coincidence for the vibrational eigenfunctions would be sufficient to reproduce the experimental values.

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Effect of Parathyroid Hormone on the Structure of Bone.

In the current issue of the *Journal of Experimental Medicine* (January 1929), Bauer, Aub, and Albright have reported that the administration of the parathyroid hormone (Parathormone, Eli Lilly), to rabbits over a period of 91 days in doses up to 8 units per diem results in a depletion of the trabeculæ of bone, without gross changes in the cortex. The X-ray plates showed that the bones contained less calcium than those of control animals belonging to the same litter, whilst the blood calcium increased to about 15 mgm. per cent as compared with a normal value of 10 mgm. per cent. In similar experiments with young rats the administration of parathormone did not give a similar result, but rather increased the number of trabeculæ and the density of the bones, whilst the blood calcium did not differ appreciably from that of untreated animals under similar conditions. With cats the results were entirely negative.

All these experiments were carried out with a diet rich in calcium.

It has for some time been recognised that the diseases osteitis fibrosa and osteomalacia are not infrequently associated with tumours or hyperplasias of the parathyroid glands. For example, parathyroid adenomata were found in the case of osteitis fibrosa described in great detail by Dawson and Struthers (1923) in a communication from this laboratory. In another case of the same disease also associated with parathyroid adenomata, more recently investigated from the biochemical point of view by one of us (C. G. L.), a very marked hypercalcæmia (17 mgm. per 100 c.c.) was found, together with a negative calcium balance (see Lambie, *Brit. Med. Jour.*, 1927). It appeared possible that in these cases the primary disturbance was the existence of the parathyroid tumour resulting in an excess production of the hormone over a long period. This would cause the hypercalcæmia, the negative calcium balance, and, presumably, the removal of calcium from the bones.

In order to test this hypothesis it was thought desirable to carry out experiments to ascertain what is in fact the effect of prolonged administration of parathyroid hormone upon the structure or bones. In preliminary experiments carried out with young growing rats, kept on an ordinary diet, in which two were used as controls and two were given 10 units each of parathormone per diem for 21 days, it was found on histological examination of the bones, that there was marked thinning of the trabeculæ in all the bones examined, especially the femora and vertebræ. In one of the two treated animals changes were also apparent in the cortex and in the epiphyseal cartilages. The bones, when dried, exhibited a greater tendency to fracture than did normal ones, and when ground up showed themselves to be more fibrous in texture. On chemical analysis it was found that the bones of the treated animals gave rise to less ash on ignition, but that the percentage of calcium in the whole bones was not significantly altered. It appears, therefore, that the inorganic ash from the treated animals actually contained more calcium than that of the untreated. This latter finding is puzzling, but may indicate a change in the form in which calcium exists in the bones of the treated animals.

These results confirm the positive findings of Bauer, Aub, and Albright as to the effect of parathyroid hormone upon the structure of bone, and it is hoped that by further experiments on these lines light may be thrown upon the pathogenesis of osteitis fibrosa, osteomalacia, and other bone dystrophies.

Bauer, Aub, and Albright (1929), *Jour. Exper. Med.*, **49**, 145.
Dawson and Struthers (1923), *Edin. Med. Jour.*, **30**, No. 10, 421.
Lambie, C. G. (1927), *Brit. Med. Jour.*, II (Oct.), 785.

C. G. Lambie.
W. O. Kermack.
W. F. Harvey.
Research Laboratory,
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Edinburgh, Feb. 13.

Spiral Markings on Carborundum Crystals.

In the course of another investigation, we have had occasion to examine crystals of carborundum under the microscope. These crystals were of very dark purplish colour with often a greenish sheen. Pure carborundum is said to show little colour, and the deep colour of the crystals of commerce is attributed to a minute quantity of free carbon, which doubtless tends to distort the lattice. Certain of our crystals exhibited, on their smooth hexagonal, basal pinakoid, surfaces, striations formed of numerous curved parallel lines, some thirty or forty microns apart, and roughly equidistant. Such striations have been mentioned in the literature. We were fortunate in finding a crystal face which showed that these markings may form a rather perfect spiral. A photomicrograph of this is reproduced as Fig. 1.

It will be seen that we are here in possession of a very clearly defined fact. Very often in science our theories are sufficiently clear, while the facts are much less so. The opposite is here true.

Three crystalline modifications of carborundum have been described, all of hexagonal symmetry, and striation by straight parallel lines occurs and calls for no comment. Spiral forms are very uncommon in inanimate Nature, but may perhaps occur when two types of crystal architecture alternate. That the observed spiral is related to the underlying hexagonal, or di-trigonal, structure may be seen from the slight flattening of the curvatures at azimuths 60° apart. Furthermore, the markings on different crystals have an obvious relation to the margins of the crystals when these are visible. It may be true that some carborundum crystals have a thin surface coating of silica, but hydrofluoric acid does not affect the markings we have observed.

FIG. 1

Not all specimens of carborundum exhibit such striation. This we have ourselves noted, while Negri, who states that he examined thousands of carborundum crystals with a hand lens and measured about one hundred on the goniometer, makes no mention of surface markings.

At its broadest portions the 'line' that forms the spiral can, interpreting merely in terms of appearances, be analysed into three lines: two marginal about six or seven microns apart (which may be the margins of a shallow channel or trough) and a third, between them, about two microns from the inside line. The outside line is in parts of its length fringed by outgoing excrescences, which may be of the same nature as the minute lozenge-shaped crystals which the photomicrograph shows lying in parallel orientations 60° apart.

Before venturing to put forward a too imaginative hypothesis, we should be glad to learn what others suggest in interpretation of this unusual phenomenon.

ALAN W. C. MENZIES.
C. A. SLOAT.

Princeton, N.J.

Polarisation of Compton Scattering according to Dirac's New Relativistic Dynamics.

IN a letter to NATURE of Dec. 1, 1928 (vol. 122, p. 843), I gave a formula for the intensity of the radiation scattered at right angles first by one and then by a second electron. In this formula, unfortunately, no account was taken of the change of frequency of the radiation during the first scattering. When this mistake, which has been kindly pointed out to me by Mr. Chr. Møller, is corrected, the formula in the letter referred to is replaced by

$$I = \frac{e^8}{2m^4c^8r^2r'^2}\frac{I_0}{(1+2\alpha)^3}\left\{\sin^2\theta + \frac{\alpha^2(2+4\alpha+3\alpha^2)}{2(1+\alpha)^2(1+2\alpha)}\right\}$$

Owing to this, the comparison of the theory with the measurements of Lukirsky comes out somewhat differently. Thus for $\theta = 0°$ the intensity is 5.3 per cent instead of 6.5 per cent of the intensity at 90°, when the wave-length is assumed to be 0.085 A., and agreement with Lukirsky's result would be obtained with a wave-length of 0.13 A. instead of 0.14 A.

Y. NISHINA.

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The Language of Science.

IT has been said yet once again (NATURE, Feb. 2, p. 161) that 1 and 1 are not always 2. With great respect to Sir Oliver Lodge, I would suggest that there is here some confusion, if not of thought, at least of language. In the common use of our language when we say 1 and 1 make 2, we imply that each unit suffers no change in being added to, or rather associated with, the other. The usual, that is, not the special physical or chemical or biological, meaning of 1 and 1 is 1 + 1, where + stands for "associated with, but involving no change in either." Thus 1 (apple or mercury globule or amoeba) and 1 (apple or mercury globule or amoeba) *always* make 2 (apples or mercury globules or amoebæ). When, however, in the phrase 1 + 1, the symbol + is distinctly defined to mean (1) reacts physically with, or (2) reacts chemically with, or (3) reacts biologically with, the result, *as experience shows*, need not be 2. For example, 1 + 1 = 1 when + means (1) and the units are mercury globules; 1 + 1 = 4 when + means (3) and the units are amoebæ. In each of these cases a *change* has taken place, not a mental or an arithmetical addition.

To express any such change by saying simply 1 and 1 are 5 is to misuse our language. To go further, and say 1 and 1 are 2 and sometimes 5, is to confuse both thought and language.

GEORGE HOPE.

221 Dalkeith Road, Edinburgh.

Hamilton's Contributions to Geometrical Optics.

WE are at present engaged in preparing for the Royal Irish Academy the first volume of a collected edition of the mathematical papers of Sir William Rowan Hamilton. This volume is to contain Hamilton's contributions to geometrical optics.

If any readers of NATURE should happen to be in possession of any mathematical manuscripts written by Hamilton, we would be glad if they would communicate with one of us.

A. W. CONWAY.
University College, Dublin.
J. L. SYNGE.
Trinity College, Dublin,
Feb. 18.

Erratum in Lodge's "Energy."

ON page 65 of numerous early copies of my little sixpenny book on "Energy," published by Messrs. Ernest Benn, Ltd., there is an erroneous reference to page 61, instead of to page 44. My object in making this reference was to call special attention to the apparently mysterious formula $ipq - iqp = h/2\pi$, which I anticipate will loom large in the physics of the future.

OLIVER LODGE.

Aspects of Fossil Botany

By Dr D H SCOTT, F R S

II EARLY FLORAS

DR CHURCH has reminded us that "the Beginnings of Botany are in the Sea" This is undoubtedly true, whether we accept his hypothesis of a universal ocean, or hold that the surface of the cooling earth was so corrugated that seas and continents co existed from the first The Plankton stage, of microscopic, free swimming organisms, postulated by Dr Church, has left no trace in the rocks We have, however, abundant evidence of the early presence of marine plants Apart from some disputable Cambrian records, we have numerous well preserved seaweeds from the Ordovician onwards It is, of course, mainly calcareous Algæ which have lent themselves to fossilisation The verticillate Siphoneæ, above all, form a fine evolutionary series, admirably investigated by Dr Julius Pia, of Vienna Their interest has perhaps scarcely been sufficiently recognised by botanists, though among geologists Prof Garwood has emphasised the importance of cal careous Algæ as rock builders The Siphoneæ, how ever, form a line of their own, without any relation to the land flora with which we are now concerned

At some unknown period the transmigration to dry land took place If we accept the theory of continents and oceans as equally ancient, it is quite probable that there may have been successive transmigrations As we shall see, highly organised land plants occur about contemporaneously with apparently primitive types Dr Bidder, in his address to Section D (Zoology) of the British Association in 1927, pointed out the probability of the early appearance of land organisms He regarded the occurrence of extensive beds of graphite in pre Cambrian rocks as evidence of an abundant vegetation in land locked waters, with every opportunity of migration on to the neigh bouring shores Thus a land vegetation may have made an early start, and some of the descendants may have persisted among later floras It is suggested that Hugh Miller's 'cone bearing tree' of the Middle Devonian may have been such a survival To quote Dr Bidder's words "There may be a class or classes of terrestrial animals or plants which have breathed air two or three times as long as those which left the sea in the Devonian"

We have, however, as yet no perfectly trust worthy record of land plants earlier than the Lower Devonian First of all there is the classical, but once disputed, *Psilophyton* of Dawson, with its rhizome, forked aerial stems, bearing thorns but no leaves, and large terminal sporangia There seems to be little doubt that Dawson's descrip tion was essentially correct The contemporary *Arthrostigma* was like a larger *Psilophyton*

The oldest known land plant with well preserved structure is *Gosslingia breconensis*, recently dis covered by Dr Heard in the Lower Devonian of South Wales In habit this was something like *Psilophyton*, the branches, as in that genus, had circinate tips It is a curious fact that circinate venation, often found in these early plants, is older than the frond itself, for it occurs on thalloid branches not yet differentiated as leaves *Gosslingia* had a well developed vascular cylinder, considerably larger than in the somewhat later Rhyniaceæ The wood was evidently developed centripetally, contrary, as it appears, to the direction in the family just mentioned Stomata were detected, as in the contemporary *Psilophyton*, in which Mr W N Edwards demonstrated them very clearly The great antiquity of the typical stoma is interesting but not surprising, for we know that this organ is common to Bryophytes and vascular plants *Gosslingia* also possessed terminal bodies which are interpreted as sporangia

It is unnecessary to recapitulate the characters of the Middle Old Red Sandstone Rhyniaceæ, now familiar to botanists A word may be said as to their relation to the Bryophytes, as indicated chiefly in the somewhat *Sphagnum* like sporogonium of *Hornea* and Halle's *Sporogonites* Dr Church has gone so far as to say that '*Rhynia* and *Hornea* between them present all the characters deduced as significant for early Bryophyta", and Prof Bower, with more caution, maintains that "the new facts are thus seen to link the Bryophytes and the Pteridophytes more closely together than ever before" We may accept this latter statement, and then the question arises whether these supposed Devonian intermediates were on the up grade or the down grade Were they on the way to become full blown Pteridophytes, or in course of reduction to a moss like level? Here we will only recall Haberlandt's opinion that the mosses were reduced forms At that time one asked But reduced from *what*? Possibly the Rhyniaceæ may suggest an answer

The late Dr Arber, at a time when only *Rhynia* was known, took a different view, for he thought that this genus represented "a now obsolete race of Thallophyta" He was so far justified that the Rhyniaceæ in their external morphology are no more complex than some purely thalloid seaweeds, such as *Polyides* or *Pycnophycus* It is an interest ing question whether any of the other early fossils suggest an algal connexion *Hicklingia* of Middle, and *Zosterophyllum* of Lower Old Red Sandstone age, both have a somewhat alga like habit, and yet were probably (certainly in the latter case) vascular plants *Pseudosporochnus* (Middle De vonian), the largest of all these plants, probably 10 ft high, with a bulbous base, thick stem and numerous fine branches, has all the appearance of a big seaweed, but this too was a vascular plant *Fœrstia furcata*, an Upper Devonian fossil, though fragmentary, combines algal structure with the spores and cuticle of a land plant As Kidston and Lang say, it "almost serves to break down any sharp distinction between Algæ and the

simplest Pteridophyta " *Milleria* (formerly *Psilophyton*), on the other hand, "appears to approach, without reaching, the more definitely fern like forms that come into evidence in the Upper Devonian " (Lang)

We may now leave these simpler types and pass on to definitely leafy plants, such as the genus *Asteroxylon* The Rhynie species, *A Mackiei*, is now well known It will be remembered that the connexion of the associated sporangia and sporangiophores with the plant has never been proved The German species, *A elberfeldense*, of perhaps somewhat later age, serves to remove any doubt, for the plant bore, towards the summit, naked branches, resembling the Rhynie sporangiophores, and in two cases sporangia were found upon them Kräusel and Weyland's species combined the external features of the form genera *Thursophyton*, *Psilophyton*, and *Hostimella* It differs in definite respects from *A Mackiei*, notably in the apparent presence of a pith in the stele of the main axis Thus *Asteroxylon* appears really to present the extraordinary combination of characters attributed to it by Kidston and Lang—the anatomy and vegetative habit of a Lycopod, with a reproductive apparatus suggesting that of some of the Carboniferous ferns Another early plant, looking like a Lycopod, is *Protolepidodendron*, only known by its external features

Among Kräusel and Weyland s discoveries at Elberfeld, in the Upper Middle Devonian, are the two oldest known Articulatæ, *Hyenia* and *Calamophyton* The most interesting point is the fructification, which in each case consists of a lax cone, bearing no bracts, but only sporangiophores, which are forked and support pendulous sporangia The absence of bracts in these ' Protoarticulatæ ' supports the view of Lady Isabel Browne that these sterile organs were a later intercalation in the Calamarian cone

The variety of Early Devonian plants was naturally far greater than the few better known types here mentioned would indicate For example, Prof Lang, in his assiduous investigation of the Old Red Sandstone flora of Scotland, found eight different kinds of spore in the fish beds of Cromarty They run up to 400μ in diameter, and some may thus have been megaspores One type has been identified by Kräusel and Weyland with the spores of the Elberfeld tree fern *Aneurophyton germanicum*

Aneurophyton was a tree fern in habit, but its affinities are quite uncertain All parts of the plant are known stem, root, fronds, and, to a certain extent, the fructification There was much secondary wood, resembling that of *Palæopitys Milleri* Quite recently the primary wood has been discovered It was solid and three lobed in transverse section, recalling that of the Lower Carboniferous genus *Stenomyelon* It is a remarkable fact that all parts of the frond show stem structure Only the ultimate leaflets are regarded as truly foliar, they have no vascular strand at all—hence the generic name The sporangia are borne in clusters on special leaflets The plant bears a general resemblance to *Eospermatopteris*, but there is no evidence of seeds *Palæopitys Milleri* (Middle Old Red of Cromarty), as just mentioned, has somewhat similar wood structure to that of *Aneurophyton*, but nothing is known of its habit The structure, while not that of a typical Gymnosperm, is more like a Gymnosperm than anything else, and to that extent may justify the discoverer's bold description of it (in 1847) as a "cone bearing tree" At any rate it is a highly organised plant to find at so low a horizon

Returning to the Elberfeld records, we must note the remarkable discovery of a Middle Devonian *Cladoxylon* (*C scoparium*), the oldest species known, and the only one in which the external habit and something of the fructification are shown The complex anatomy is exactly that of the well known species first described by Unger in 1856 The leaves are numerous, small, forked appendages, very different from the large fronds which, on anatomical evidence, appear to have characterised the Thuringian Cladoxylons It has been suggested by Dr Hirmer that the genus (following the analogy of *Asteroxylon*) possessed leaves of two categories, the small appendages of the Elberfeld species representing Lygnier s ' phylloids,' while the massive fronds of the later forms were true leaves derived from modified branch systems The sporangia of *C scoparium* were borne on the margins of lobed outgrowths, differing in shape from the vegetative foliage Nothing was found to support the hypothesis that *Cladoxylon* belonged to the Pteridosperms

We have, in fact, apart from *Eospermatopteris*, no direct evidence for the occurrence of seed plants in Devonian times The leaves of the genus *Psygmophyllum*, which goes back at least to the Middle Devonian, are somewhat like those of the Maidenhair tree, and appear to have belonged to woody plants One may imagine that we have in them an early race of Gymnosperms, but habit is notoriously deceptive A fossil found in the Middle Old Red Sandstone of both Orkney and Caithness, named *Hostimella racemosa* by Lang, bears lateral bodies which may be either sporangia or seeds, no spores could be obtained from them, but neither is there any evidence of seed nature

We now come to *Eospermatopteris*, the tree of the fossil forest of Gilboa in the State of New York A great flood on the Schoharie Creek exposed five stumps in 1869 They were referred to Sir William Dawson, who named them as two species, *Psaronius erianus* and *P textilis* It turned out to be true that the plants were really tree ferns in habit In recent years further exposures have revealed hundreds of stumps scattered over a district 1⅜ miles in length, and occurring at three different levels The stumps attain a diameter of 3 feet or more Portions of the stem and large compound fronds of the plants are associated with the rooted stumps Seeds were first detected by Dr Ruedemann in 1920 There are numerous specimens associated with fragments of the fronds They were investigated by Miss Goldring, who has published full and excellent descriptions, to her the name *Eospermatopteris* is due The seeds are

borne, often in pairs, on stalks, they are about 5 6 mm long by 3 mm broad, and are described as cupulate They appear to be perfectly clear seeds, so far as impressions can show Male organs, rather large terminal discs, with apparent impressions of sporangia on the lower surface, have also been observed This, then, is the oldest seed plant known, for the age is undoubtedly no later than Upper Devonian

We may now briefly review the results of our rapid survey Recent research has revealed, in the Early Devonian vascular plants far simpler in structure than any known before We can no longer regard these simpler types as reduced, for there are too many of them With these primitive forms, however, much more advanced types are associated, possibly, as Dr Bidder suggests, the survivors of an earlier land flora

Lignier's theory of the double origin of the leaf, from emergences forming 'phylloids,' on one hand, and from thallus branches forming true leaves, on the other, seems to find strong confirmation from the early flora, as, for example, in *Asteroxylon* In many cases the circinate tips of thalloid branches clearly indicate incipient fronds

On the whole, the data now available favour the rise of the land flora from a well developed thalloid stock of marine origin, which branched out into the two main Archegoniate lines, the mosses and the ferns

The Progress of Marine Propulsion

By Engineer Captain Edgar C Smith O B E R N

NEVER since Fulton launched the *Clermont* or Bell built the *Comet* has there at any time been a fixed or standard type of machinery for all ships Inventions improvements innovations have followed in rapid succession, and the history of marine engineering presents an endless and bewildering variety of engines and boilers which have been adopted one day, only to be superseded by better ones the next With all this change and development however designers have never before been faced with the problem of choosing between so many rival methods of driving ships as they have to day each method of propulsion making by its performance or promise some claim to consideration Modern marine engineering embraces in its scope not only steam boilers and steam engines, but also steam turbines oil engines of various types, and also the use of electricity on an extensive scale

One of the most notable steps in the progress of the marine engine was the adoption of compound working associated with the name of John Elder, another the introduction of the triple expansion engine by Alexander Kirk, another stage in marine propulsion was marked by the application of the Parsons steam turbine, while to day there is an ever-increasing fleet of ships driven by Diesel oil engines The advance made during the last sixty years will be realised by comparing the Cunard ships of 1860 with modern liners Then no Cunard ship used more than 30 lb pressure in her boilers the greatest horse power in any ship was 4200, found in the *Scotia*, while the coal consumption was 3 3½ lb per h p per hour To day, ships are running with 350 400 lb pressure, the total horse power of a big Atlantic liner is 70 000 80 000, while in the most modern steam machinery less than ¾ lb of oil per h p per hour is used At one time, Great Britain built 80 per cent of the steamships of the world Owing to various causes, one of which is the rise of great shipbuilding yards abroad, this proportion has fallen considerably, yet the volume of construction and marine engineering remains very large, and there is no slackening of the effort to maintain our position For a long period marine engineering was largely a matter of experience and rule of thumb but to day it is not only influenced at every stage by scientific research, but sometimes very costly large scale experiments are made and the industry is ready to try out any new system which offers reasonable expectation of success Very great popular interest was taken formerly in the records of the ships of the 'Atlantic ferry,' the blue riband of which has now been held for twenty two years by the famous *Mauretania* During the coming summer the new German turbine driven liners *Europa* and *Bremen* are due for completion, and it may be that for a time the Atlantic record will pass to Germany as it did some thirty years ago

Apart from the new machinery for very large and fast ships however there are many developments taking place, and a few particulars of recent marine practice may be of value to those who though not directly associated with marine engineering may nevertheless be engaged in the study of some of the numerous problems which are connected with it Marine engineering to day owes very much to the mathematician, the chemist, the physicist and the metallurgist

Confining this article to recent steam practice, it is proposed to give a few notes on up to date boiler work and then refer to some recent improvements in reciprocating engines, steam turbines, and electric transmission gear At first simply great square or oblong boxes with internal flues or with banks of tubes in place of flues, sixty years ago the box boilers gave way to the cylindrical or Scotch boilers, and these have been used until recently almost without exception in merchant ships Such boilers are suitable for steam pressures up to 200 lb or even 250 lb pressure, but with still higher pressures marine engineers have had to follow naval engineering practice and use one or other of the many types of water tube boilers, of which the Babcock and Wilcox and the Yarrow are favourite examples

In the successful working of water tube boilers, a supply of pure water free from grease or scale-forming substances is an absolute necessity In high pressure steam vessels the condenser is

still the Achilles heel of the machinery, and any leakage of the condenser tubes is a source of great anxiety Some of the most interesting boiler installations of recent times are seen in the new vessels of the Canadian Pacific Railway Company, such as the *Duchess of Bedford*, *Duchess of Atholl*, and *Duchess of York* These vessels are driven by steam turbines with single reduction gear Each of them has six Yarrow boilers working at 350 370 lb per sq in with 250° of superheat, and also two Scotch boilers working at 200 lb pressure All the steam from the Yarrow boilers and a part of the steam from the Scotch boilers passes to the turbines, but it is the latter which supply steam to the auxiliary engines Separate condensing and separate feed systems are used, and by this means oil which happens to pass over from the auxiliary engines is prevented from entering the Yarrow boilers Salt and grease in high pressure boilers are things to be avoided at all costs By the use of high pressure superheated steam in these Canadian Pacific vessels, it is expected to be able to reduce the running costs by 20 30 per cent

While the turning of the water into steam, and the condensation of the steam and its return to the boiler as feed water, present the marine engineer with one set of problems involving questions such as the conduction and transmission of heat, the flow of cooling water through tubes and the prevention of deposits and corrosion in condensers and boilers, the burning of the fuel affords ample scope for ingenuity and experiment in another direction Important mercantile steam vessels, like warships, have abandoned coal for oil, but now the possibilities of burning coal in the pulverised state are being explored Reference was made to this by Sir Eustace D'Eyncourt in his paper on "Fuel for Ships," read to the Royal Society of Arts on Dec 5 of last year

Pulverised coal has been used in large boilers in some important power stations ashore for some time, and now in the American ships *Mercer* and *Lingan* and the British ships *Stuartstar* and *Horotata*, various pulverised coal systems are on trial The *Mercer* was the first ship with pulverised coal to cross the Atlantic, the *Stuartstar* is the first British ship to be fitted with a pulverising plant, and the *Horotata* is the largest ship so fitted Many firms have carried out experiments, and it is apparently only a question of time before the main problems of crushing, pulverising, distribution and burning will have been solved There may possibly be a great future for pulverised coal for ships

In the propelling machinery itself, many changes are being made, all with the object of improving economy and reducing running costs The first essential for marine machinery is trustworthiness, but with present-day manufacture and design, few serious breakdowns occur in any of the various types Triple expansion and quadruple expansion engines have been fitted for many years and, in spite of the progress of the steam turbine and the oil engine, the reciprocating engine is found in more ships than is any other engine In triple expansion engines new valve gears are being tried, while a very promising development is the fitting of an exhaust steam turbine in series with the reciprocating engine and coupled to the same shaft through reduction gearing Suggested by Sir Charles Parsons, but introduced first in Germany, this plan is known as the Bauer Wach exhaust turbine system The Anchor liner *Britannia*, a vessel of 8464 tons, built two years ago, has just had such a turbine fitted to her quadruple expansion engines, resulting in an increase of power with a reduction in oil consumption per horse power, and other vessels are being similarly altered, among them being five P and O ships running to Australia via the Cape In view of the large number of ships with reciprocating engines, it may be expected that exhaust turbines will be adopted on a wide scale

Marine engineering has always been influenced by contemporary land practice, but up to the coming of the steam turbine no power station contained machinery comparable in size to that of an Atlantic liner The steam turbine to some extent has reversed that position, but while the largest single unit turbines are found in the super power houses, practice ashore and afloat tends to progress on parallel lines, higher pressures and higher temperatures being used in both cases Then, too, marine steam turbines to day drive the propeller shaft through reduction gearing, instead of directly, or alternatively use hydraulic or electric transmission The introduction of reduction gearing with pinions and wheels with helical teeth cut with extreme accuracy led to a great increase in both turbine and propeller efficiency In a presidential address delivered about two years ago, Engineer Admiral Sir Robert Dixon stated that in torpedo boat destroyers the use of gearing had led to an increase in the distance steamed per ton of oil of 14 per cent at full speed and 70 per cent at cruising speed With the use of gearing came the introduction of the single collar thrust block invented by Michell of Australia, a solution of a difficult problem as complete as it was unexpected In the development of the turbine, the gearing and the thrust block are seen many striking results of the successful application of theoretical investigations to urgent practical problems of ship propulsion

For the transmission of the power of the turbine to the propeller shaft, electricity has been used extensively in the United States Navy, which tried out the system first in the collier *Neptune*, now the aircraft carrier *Langley* This system is also found in about thirty ships with a collective horse power of 500,000 plying on the Great Lakes Much interest was created last year by the performances of the American Panama Pacific Liner *California*, with turbo electric machinery, and in view of the recent completion of the P and O *Viceroy of India* with turbo electric machinery, comparative figures may be of interest Though tried in an experimental launch, the *Electric Arc*, in 1911, and in the s s *Tynemount* in 1912, the electric drive has not previously been fitted in any large British ship, and the running of *Viceroy of India* will be

watched by every superintendent engineer The *California* is 601 feet long and has a gross tonnage of more than 20,000 tons Steam is supplied by oil fired Babcock and Wilcox boilers at 275 lb pressure and 120° F superheat to two turbo alternators, each of 8500 s h p running at 2880 revolutions per minute, which supply current to the twin screw propelling motors running at 120 r p m At full power the vessel has a speed of 18 knots, and the consumption of oil on the first voyage for all purposes was 0 8 lb per h p The *Viceroy of India* is 612 feet long, with a gross tonnage of 19,000 and a displacement of 25,000 tons In her, six Yarrow boilers supply steam at 350 lb pressure to two 9000 k w turbo alternators running at 2700 r p m supplying current to twin screw motors running at 109 r p m The speed of the ship at full speed will be 18¾ knots, while with only one alternator in use a speed of 16½ knots will be obtained It is stated that the guaranteed con sumption for propelling purposes only is 0 6 lb per s h p per hour Besides the main generators, the *Viceroy of India* has four 500 k w auxiliary turbo generator sets and two 165 k w oil-driven sets, while for the pumps, fans, steering motors, etc , which are electrically driven, there are no fewer than forty three circuits This notable vessel is advertised to sail on her maiden voyage on Mar 28 It has been announced that the new 'Super-Olympic' liner building at Belfast for the White Star Line will also have electric drive, but parti-culars of her machinery have not yet been pub-lished

Progress in steam marine machinery has un questionably been stimulated by the growing popularity of the motor driven ship with its sur prising economy in fuel For fast ships and war-ships, however, the steam turbine is at present the only suitable engine, while in other classes of vessels no doubt various types will continue to be used according to circumstances In Lloyd's Register Book the tonnage of ships above 100 tons included amounts to 65,159,413 tons gross, of which 5,432,302 tons are driven by oil engines, 9,682,063 tons by steam turbines, and 50,045,048 tons by steam reciprocating engines, while of the total tonnage 62 4 per cent burn coal and 37 6 per cent use oil either under the boilers or in the engines Some of the steamers fitted for burning oil can if necessary use coal

Obituary

Sir Bertram Windle, F R S

It is with deep regret that we record the death of Sir Bertram Windle, professor of anthropology in St Michael's College, University of Toronto, which took place in Toronto on Feb 14 Bertram Coghill Alan Windle was born on May 8, 1858, the son of the Rev S A Windle, vicar of Market Rasen, Lincolnshire He was educated at Kings town and Repton schools, and had a distinguished career at the University of Dublin, where he gradu ated M D and D Sc He was for a time Dean of the Medical Faculty and professor of anatomy and anthropology at the University of Birmingham He afterwards became professor of archæology in University College, Cork, of which he was appointed president in 1904, holding this office from 1904 until 1919, when he went to Toronto During his residence in Ireland he was extremely active in educational and other affairs, with results that were not always conducive to his tranquillity of mind

In his more strictly professional studies, Windle attained considerable eminence His contribu tions to anthropological literature were marked by originality and freshness of view Besides papers in scientific journals, he was the author of a manual of surface anatomy, now in its third edition, and of "The Proportions of the Human Body," pub-lished in 1892 He was, however, almost as widely known as an archæologist as an anatomist He published several books on prehistoric archæology, of which the best known are "Life in Early Britain" and "The Prehistoric Age" His "Romans in Britain" was of a more popular character and was based on lectures delivered in Toronto He was elected a fellow of the Royal Society in 1899 The breadth of his interests was also shown in a series of literary guide books, of which "Shakespeare's Country" is most likely to be of enduring value

Windle's main preoccupation, however, outside his professional studies, was in religious questions, and especially the relations of religion and science At the age of twenty five he joined the Roman Catholic Church, and by far the greater part of his not inconsiderable literary output was concerned with religion "The Church and Science" was awarded the Gunning Prize in 1917, and Windle was honoured for his writings by two popes, Pius X made him a knight of the order of St Gregory, and Pius XI made him an honorary Ph D

News has just reached us of the death on Jan 17 at Moscow of Dr G S Zaitzev, director of the Turkestan Plant Breeding Station Beginning in 1914, Dr G S Zaitzev devoted himself to serious and large scale genetic, botanical and breed ing work in cotton, occupying the position of the chief of the Division of Plant Breeding of the Golod nostepskay Agricultural Experiment Station until 1919 In 1919 Dr Zaitzev was appointed director of the Turkestan Plant Breeding Station, where he remained until his death, which has interrupted a life full of scientific achievements in our know-ledge of the cotton plant In addition to his work at the Turkestan Plant Breeding Station, Dr Zaitzev was engaged in the U S S R Institute of Applied Botany (Leningrad) as cotton specialist, and in the Central Asia State University (Tashkent) as professor of cotton growing at the Agricultural College By the death of Dr Zaitzev, the Soviet Union and the whole world have lost a distinguished scientific worker in the field of genetics and plant breeding, whose memory will be long preserved and honoured

News and Views.

THE following names of scientific workers and others associated with scientific activities appear in the New Year's honours list, which, owing to the illness of His Majesty the King, was not issued until Mar 1 *Barons* Sir Jesse Boot, for services in the promotion of education, Sir Berkeley Moynihan, president of the Royal College of Surgeons *Knights* Prof J A. Fleming, emeritus professor of electrical engineering, University College, London, Mr G A Julius, chairman of the Council for Scientific and Industrial Research, Commonwealth of Australia, Col T F Purves, Engineer in Chief, Post Office, Mr A V Roe, for distinguished services to British aviation, Sardar Jogendra Singh, Minister for Agriculture, Punjab, Lee ah Yain, Minister for Forests, Burma, *Companion of Honour* Lady Florence Elizabeth Barrett, Dean of the London School of Medicine for Women and president of the Medical Women's International Association *C B* Sir Walter Morley Fletcher, secretary of the Medical Research Council, Dr G F Hill, Keeper of the Department of Coins and Medals, British Museum *C M G* Mr F C Madden, Dean of the Faculty of Medicine, Egyptian University, Cairo *K C I E* Sir Thomas Middleton, lately member of the Royal Commission on Agriculture in India *C I E* Mr R S Finlow, Director of Agriculture, Bengal Mr N N Gangulee, lately member of the Royal Commission on Agriculture in India, Mr J A Madan, lately joint secretary to the Royal Commission on Agriculture in India, Mr W Mayes, Chief Conservator of Forests, Punjab, Mr F W H Smith, lately joint secretary to the Royal Commission on Agriculture in India *G B E* Sir William McCormick, chairman of the University Grants Committee and of the Advisory Council of the Department of Scientific and Industrial Research *D B E* Prof Anne Louise McIlroy, professor of obstetrics and gynæcology, Royal Free Hospital School of Medicine for Women, University of London *C B E* Prof Winifred Cullis, professor of physiology, London (Royal Free Hospital) School of Medicine for Women, Mr R Hewison, late Director of Agriculture and Forests, Sudan Government, Mr W Nowell, Director of the Amani Research Institute, Tanganyika Territory *O B E* Mr G E Hunt, lecturer in engineering, Gordon College, Khartoum, Mr W A Taylor, superintending examiner, Patent Office *M B E* Mr G E Holden, technical adviser to the Dyestuffs Advisory Licensing Committee, Mr A J W Hornby, agricultural chemist, Nyasaland Protectorate

WE publish elsewhere in this issue a résumé of a detailed research on the performance of ammeters and voltmeters made by the British Scientific Instrument Research Association, of which the director is Sir Herbert Jackson The research is of a somewhat novel type, but there can be no question about the usefulness of this kind of research to industrial undertakings, and we hope that it will be widely followed The research was initiated by some members of the Association, who were naturally disturbed by the disparaging remarks made by a few station engineers about British switchboard instruments They desired that a critical examination be made of the operation, appearance, and permanent qualities of British and foreign ammeters and voltmeters for use on switchboards in central electrical stations In order to bring the research within manageable limits it was restricted in the first place to permanent magnet moving coil instruments The research was to be impartial and thorough, the best foreign and British instruments being obtained from well known makers

THE results of this investigation of British and other ammeters and voltmeters are satisfactory from the point of view of the British manufacturers Naturally there is much in the detailed report which is confidential to members of the Association, but the synopsis proves conclusively that their products were at least as good as those of their American and continental rivals The greatest value of the report, however, lies in the criticisms made freely about all the instruments and the reasons given why certain makes are more desirable than others These criticisms should prove most useful to the designer As a rule, design is largely a compromise the better the instrument is made in one respect the worse it is in another It is largely a balancing of incompatibilities, and the successful maker is the one who secures the best balance The nature of the materials used for the instruments has been examined, and such questions as to the relative merits of aluminium and copper wire for use in winding the coils is fully discussed To manufacturers this kind of research is of the greatest value, and we congratulate the Association on its report

REFERENCE is made in the *Times* of Mar 2 to a biennial fibre plant to which the name 'Brotex' has been given The plant is being grown on a small scale near Totnes in South Devon, and it is claimed that in less than eighteen months from planting it will produce fibre for textiles, cellulose for paper making, and seed containing oil suitable for cattle food That a plant with so many desirable qualities, which will survive the winter in the south of England, should only now have been brought to notice, is somewhat remarkable and merits further investigation It is stated that the plant grows to a height of about 10 feet in the course of 15 18 months, but nothing is said as to the soil exhaustion that is likely to take place with a crop of this kind, nor is it pointed out that land suitable for such a crop is somewhat limited in the south west of England

THE "evolution of the plant" has not been disclosed, pending application for patents, though it has been stated elsewhere to be of hybrid origin It is known, however, that it belongs to the genus *Lavatera* of the family Malvaceæ, and the plants now being grown in Devonshire very closely resemble a species which is a native of the Canary Islands, a plant which would certainly be hardy only near the warm south-

west coast of England in normal winters The mallow family contains many well known fibre yielding plants, such as *Abutilon Avicennæ* (the source of Chinese jute), *Hibiscus cannabinus*, *Sida rhombifolia*, etc, and in some cases the seeds are also of value for cattle food None of these plants is hardy in Great Britain, and even *Lavatera arborea*, which is the only *Lavatera* found in England, will only succeed well near the coast If, therefore, 'Brotex' can be proved to be of hybrid origin, not only will it be of scientific interest to know its parentage, but it will also be of material importance to know whether it will regularly produce fertile seed in Great Britain Moreover, it is of importance, from the commercial aspect, to know whether the fibre is superior to jute and hemp, with which fibres we understand the market is already fully supplied

A TIMELY article by Sir Oliver Lodge appears in *The Nineteenth Century* for March on the philosophy of "the genius who now lives among us and whom we call Eddington," as expressed in the latter's recent book, "The Nature of the Physical World" After expressing his agreement with the greater part of Eddington's thesis, Sir Oliver proceeds, in a perhaps unnecessarily apologetic manner, to deal with one or two contentions against which, as he expresses it, "I politely and reasonably rebel" The points which he discusses are respectively the tendency to regard the subject matter of science as confined to quantities which can be measured, and the abandonment of the notion of force in the descriptions of field physics On the second point Sir Oliver affirms his belief in the reality of a physical force exerted by the strained ether on a body placed in a gravitational field Eddington, in company with all orthodox relativists, prefers to express the facts in terms of the geometrical properties of the field To a large extent, if not wholly, the difference here is merely verbal, but the first point, concerning the essential character of science, deals with more fundamental issues The suggestion that phenomena or ideas which cannot be measured are not amenable to scientific treatment has taken immediate root in the minds of philosophical writers, and its foliage seriously threatens the survival of the finer blooms of thought which have been reared with much greater difficulty

THE simplicity of this false generalisation has gained for it a rapturous welcome from philosophers bewildered by the headlong advances of modern physics, and the relations between science and religion in particular are in consequence viewed in an entirely false light The subject matter of science is the common experience, obtained through the five senses (the so called *observations*), of the generality of observers The purpose of science is to record and correlate such observations Measurement may—in fact, does—assist both the recording and the correlation, but it does not dominate them It is not, for example, exclusively employed—nor can it probably ever be—in recording the behaviour of a spider placed in a hive of bees, or in correlating the movements of swallows with the declination of the sun, yet these activities are certainly fair game for scientific investigation A careful perusal of Eddington's book will show that it contains no specific warrant for the misconception, but if, as we believe, a writer of outstanding authority should guard as much against misinterpretation by the casual as by the meticulous reader, he can perhaps not be wholly absolved from responsibility for its prevalence That, however, is of secondary importance What is chiefly to be desired is that the true nature of science shall be clearly understood, and Sir Oliver Lodge's article should help considerably towards this end

THE eighth Annual Report of the National Institute of Industrial Psychology shows a steadily progressive increase in the interest taken by firms in the application of the principles of physiology and psychology to industry The range of the Institute's investigation services during 1928, as judged by the fees received, has expanded by 29 per cent in comparison with the previous year A most diverse array of activities is represented by the list of investigations, which include spinning, the manufacture of electric light fittings, pickles jam, and soap the selection of staff and the layout of large stores, to mention but a few There has also been growth in the other departments of the Institute's work, for example, in vocational guidance, research, and education It is hoped during 1929 to inaugurate a new department for the purpose of applying to the problems of the home those principles which have been found useful in other fields The second part of the report gives an outline of some of the investigations undertaken during the year The third part records the research work for the year, this includes experiments in vocational guidance in London and Fife, an inquiry into occupations suitable for the blind, and a varied number of researches initiated or continued with the grant given by the Laura Spelman Rockefeller Memorial It is clearly a record of most important and useful work

PROF J REILLY and D T MacSweeney give an account, in the *Proceedings of the Royal Dublin Society* for January, No 15, of the work of William Higgins, whose book, published in 1789, "A Comparative View of the Phlogistic and Antiphlogistic Doctrines," contains some interesting speculations on chemical combination The work is the first defence of the new views of Lavoisier in the English language and was written in answer to Kirwan's "Essay on Phlogiston" Higgins' work, according to Reilly and MacSweeney, contained the fundamental germs of the chemical atomic theory, and had it not been neglected it would have led to much that Dalton afterwards put forward It is to the genius and industry of Dalton, and the encouragement and friendly criticism of his contemporaries, that the main credit for the establishment of the theory must be ascribed Higgins' work (which is based on experiment and is by no means purely speculative) is particularly interesting in its attempt to represent affinities as well as combining proportions, a side of the subject which was, perhaps wisely, entirely

(*Continued on p* 385)

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Reviews.

Population and Depopulation

(1) *The Balance of Births and Deaths* Vol 1 *Western and Northern Europe* By Robert R Kuczynski (The Institute of Economics of the Brookings Institution) Pp xii+140 (London George Allen and Unwin, Ltd, New York The Macmillan Co, 1928) 10s net

(2) *The Shadow of the World's Future or the Earth's Population Possibilities and the Consequences of the Present Rate of Increase of the Earth's Inhabitants* By Sir George Handley Knibbs Pp 131 (London Ernest Benn, Ltd, 1928) 10s 6d net

AT the World Population Conference held at Geneva in 1927, one might observe a contrast in viewpoint of the very greatest interest The delegates from the United States were much concerned with the imminence of the dangers of over population, while the majority of European speakers, at least those who spoke with authority on their own national statistics pointed out in almost monotonous succession that their birth rates either had already fallen or would soon fall below the level necessary to maintain stationary populations Generally speaking, northern Europe has seen the end of the period of population expansion Is it possible that the American average of 39 to the square mile is more impressive of over population than the European average of about 300?

In the preface to his book, Sir George Knibbs says (p 5)

" it shows that the menace of the present rate of growth of those inhabitants is most serious This rate is of the order of about 1 per cent per annum"

Mr R R Kuczynski, on the contrary, remarks in his introduction

"In case, then, that natality does not again increase, the population of England is bound to die out no matter how low mortality may be reduced And this state of affairs is by no means confined to England Conditions are about the same in Germany, and only slightly better in France"

The scope of the two books is very different Sir George Knibbs considers the earth as a whole, Mr Kuczynski takes northern and western Europe, while succeeding volumes of his series will deal with other regions "The Shadow of the World's Future" is to influence national policies in respect of population, migration, and food production "The Balance of Births and Deaths" is concerned with a detailed statement of the relevant statistical facts, collated for the whole group of countries considered It confines itself strictly to the existing tendencies in the growth or decline of populations, whereas the rate "of the order of about 1 per cent per annum" is practically the only statement on this subject which seems necessary for 'The Shadow of the World's Future" One book is scientific, the other, political

(1) To take the scientific book first It has four short chapters on 'Birth Rates," "Fertility Rates," 'Net Reproduction Rates," and "Present and Future Tendencies," followed by four long, and largely tabular, appendices Fertility rates are birth rates based on the numbers of women actually available for reproduction They lead to gross reproduction rates giving the number of live daughters born per woman For 1927 the value for Germany has fallen to 1 00 and for England to 0 98 Even with no mortality in infancy and childhood these figures are incompatible with biological increase For the whole area in 1926 the value is 1 12

In the net reproductive rates allowance is made for mortality, the figures may, in fact, be read as the actual births expressed as percentages of those needed to maintain a stationary population The estimates for 1926 are for England 88, Germany 89, France 94, Sweden 95, Denmark 110, Finland 109, and for the whole area about 93 These values also are falling rapidly, for in 1927 the estimates are France 91, Germany 83, England 82

The main points, which are being but slowly apprehended in Great Britain, are brought out with perfect lucidity For example, that the present populations have an unusually large proportion of persons of reproductive age, and unusually few of the elderly, that the course of the changes in

reproduction has not been appreciably changed by the War, and that, since the mortality rates of persons above the reproductive age are without effect upon future population growth, the present tendencies to decreasing population can only be appreciably altered by increasing fertility

(2) Sir George Knibbs's fears seem to be centred upon somewhat improbable prospects of the increase in the world's population He allows that the earth's resources, if wisely exploited, would support about 7800 millions of human beings This seems a very handsome allowance, being four times the total existing world population Trouble is anticipated (p 118) from "the mere increase in population, coupled with the fact that Man's moral development has not kept pace with scientific knowledge" The threatening shadow sometimes takes the appearance of a bogy (p 119)

"We are rapidly approaching numbers that make the problem a stupendous, aye, an appalling one"

Should 2000 millions induce more stupor than 1900 millions?

The chapter on the world's cereal and food crops is of course written on the assumption that there is an immediate prospect of the demand for food outrunning the supply No evidence is adduced that this is so, and the evidence to the contrary is ignored entirely It might be strongly argued that the situation at present and the prospects of the immediate future indicate a systematic over production of foodstuffs Agriculture throughout the world is a depressed occupation in the sense that the worker on the land works harder for a lower economic recompense than the worker in any other industry In agriculture the crops which pay best are either luxury foods or not food crops at all Falling food prices have caused an increased consumption per head in most countries but the increase is naturally least in the staple foods and greatest in the delicacies What agriculture needs is higher prices for staple foodstuffs, relatively to the cost of buildings, clothes, and machinery, but with new areas still apparently yearning for agricultural development, the prospect of better prices is far off It has indeed been calculated that the rate of increase in the supply of fixed nitrogen as fertilisers would more than suffice to meet the present rate of world population increase without putting a single new acre under cultivation However this may be, the supply of foodstuffs is elastic enough, it is the demand that is inelastic From Sir George Knibbs's point of view it is, however, worth while discussing the most extravagant methods of increasing yields (p 40)

" but it has recently been shown that greatly increased yields are at least temporarily attainable with cereals by transplanting The increased yields are due to the greater root development thus obtained The use of carbon dioxide has also led to higher yields In any case these results, *while they relieve the outlook for the immediate future* [Reviewer's italics], do not warrant any disregard for the outlook resulting from population increase"

While such diversities exist in intelligent opinion as are shown by these two books, there can be no doubt of the need for bodies devoted to eliciting the real facts, such as the British Population Society, for the parent international body of which Sir George Knibbs puts in a warm plea

R A FISHER

Old English Versions of Alchemical Texts

The Works of Geber Englished by Richard Russell, 1678 A new edition, with Introduction by Dr E J Holmyard Pp xl+264 (London and Toronto J M Dent and Sons, Ltd, New York E P Dutton and Co, Inc, 1928) 6s net

ENGLISH scholars first became interested in the translation of alchemical texts in the twelfth century, when they participated with the celebrated Gerard of Cremona and other continental scholars in making known to western Europe the accumulated wisdom of the Muslim world Prominent among them were Adelard of Bath, Walcher of Malvern, Roger of Hereford, and Robert of Chester, the last named of whom, according to tradition, first introduced chemistry into Europe "Since," wrote Robert, in the preface to his first translation of an Arabic alchemical treatise, in 1144, "your Latin world does not yet know what alchemy is, I will explain in the present book" The translations of this period were of course done into Latin, and the same language was the usual medium in which the adepts embodied, or embedded, their observations and ideas throughout the succeeding five centuries

The "Speculum Alchemiæ" of Roger Bacon, the earliest alchemical work of any note by an English author, was first translated from Latin into English in 1597, it appeared under the title "The Mirror of Alchimy," and is now very rare Printed in company with Bacon's "Speculum" and other works, in such editions as those dated 1541 (Nuremberg) and 1545 (Berne), were certain Latin texts ascribed to Geber (Jabir) These texts, which can be traced back through the first printed edition of about 1481

to manuscript versions of the early thirteenth century, were first translated into English in 1678 by Richard Russell, under the title "The Works of Geber, The Most Famous Arabian Prince and Philosopher Faithfully Englished by R R a Lover of Chymistry" The English translation was reprinted in 1686, and it has now attained the distinction, after an interval of exactly 250 years from its original publication, of appearing in a third edition, enriched with reproductions of the bold woodcuts of alchemical apparatus which embellished the Latin edition of 1545

In an interesting preface, Dr Holmyard points out that no Arabic originals of the text are known, so that its authenticity is unproved After considering the available evidence bearing upon the origin of the writings, he reaches the conclusion that 'whatever the future may disclose concerning them, we may safely say that they are not unworthy of Jabir and that he is worthy of them, and that we know of no other chemist, Muslim or Christian, who could for one moment be imagined to have written them" The main sections of the book are entitled "Of the Investigation or Search of Perfection," 'Of the Sum of Perfection, or of the Perfect Magistery," "Of the Invention of Verity, or Perfection," and 'Of Furnaces, etc, With a Recapitulation of the Authors Experiments"

Possibly the most interesting part is the account "of the Natural Principles of Metals, according to the Opinion of Modern Philosophers, and of the Author,' of "the Three Principles, viz Sulphur, Arsenick, and Argentvive," and of the six "Metallick Bodies, which are the Effect of these Principles of Nature' The description of sulphur as "a fatness of the Earth" is suggestive of the statement of Paracelsus that "the life of Metalls is a secret fatnesse, which they have received from Sulphur, which is manifest by their flowing" The second principle, Arsenick, "needs not be otherwise defined than Sulphur But it is diversified from Sulphur in this, viz because it is easily a Tincture of Whiteness, but of Redness most difficultly and Sulphur of Whiteness most difficultly but of Redness easily" The third principle, Argentvive, or Mercury, "is a viscous Water in the Bowels of the Earth It is also (as some say) the Matter of Metals with Sulphur And it easily adheres to Saturn, and Jupiter, and Sol Therefore hence you may collect a very great Secret For it is amicable, and pleasing to Metals, and the Medium of conjoyning Tinctures"

The metals are described in vivid terms, which suggest a close acquaintance of the writer with their properties Gold is "Citrine, ponderous, mute, fulgid under the Hammer extensible, fusible, and sustaining the Tryal of the Cupel, and Cement" Silver is "White with pure Whiteness, Clean, Hard, Sounding" Lead is 'livid, earthy, ponderous, mute" Copper and iron are characterised with equal felicity, finally,

"not omitting to discourse of Jupiter, We signifie to the Sons of Learning, that Tin is a Metallick Body, white, not pure, livid, and sounding little, partaking of little Earthiness, possessing in its Root Harshness, Softness, and Swiftness of Liquefaction, without Ignition, and not abiding the Cupel, or Cement, but Extensible under the Hammer Therefore, Jupiter, among Bodies diminished from Perfection, is in the Radix of its Nature of Affinity to the more Perfect, viz to Sol and Luna, more to Luna, but less to Sol, as shall be clearly declared in the following Jupiter, because it receives much Whiteness from the Radix of its Generation, therefore it whitens all Bodies not White, yet its vice is, that it breaks every Body, but Saturn, and most pure Sol And he who knows how to take away its Vice of breaking will suddenly reap the fruit of his Labour with joy"

These quotations serve a twofold purpose In the first place, they afford an indication of the views upon the constitution of the metals which prevailed, with unimportant modifications, from the time of Jabir (c 721–813) for a period of nearly a thousand years Secondly, they illustrate the peculiar fitness of the seventeenth century mind for interpreting, and recording in the vigorous English of the day, the philosophy, the mysticism, and the superstition of the alchemists, from Jabir to Paracelsus and Glauber Thus, Richard Russell imparts alike to the "Works of Geber," to "Beguinus his Tyrocinium," and to "the Triumphant Chariot of Antimony, with Kirkringius his Notes thereon," the same archaic flavour and picturesque charm which Lord Berners infused in the preceding century into his English version of Froissart's "cronycles of Englande, Fraunce, Spayne, Portyngale, Scotlande, Bretayne, Flaūders, and other places adioynynge"

A similar atmosphere permeates the writings of Russell's contemporary, John French, the translator of Glauber, Sendivogius and Paracelsus, and of "a Chymicall Dictionary explaining hard places and words met withall in the writings of Paracelsus, and other obscure authors" "Are not Philosophers," asks French in his introduction to Glauber's "Description of new Philosophical Furnaces," published in 1651, "the best moralised men, of the purest lives, and most serviceable in their generation? It shall be my practise as long as I

live to be instrumental in promoting true knowledge, whether by way of Translation or any other way of making what is occult manifest "

Boyle's "Sceptical Chymist" (1661) marked alike the decline of alchemy and the gradual abandonment of Latin by exponents of the new chemistry which was to arise Nevertheless, Walter Harris and others continued the tradition of the seventeenth century translators, and no true "Lover of Chymistry' would willingly forgo such passages as Boyle's own quotation of the experience of the Dutch sailors at Nova Zembla with a barrel of frozen beer in the winter of 1596, and Harris's description, in his Englished version of Lemery's "Cours de Chymie,' of the rectification of spirits of wine, to which end, he says, "Artists have invented a long Machine, which they call the Serpent, by reason of the circumvolutions which it makes"

Dr Holmyard has earned the gratitude of the present generation of "chymicall Artists" by placing such rare classical works as Russell's 'Geber and Norton's Ordinall within their reach May we not persuade him to complete the "tria prima by preparing a new edition of Roger Bacon's 'Mirror of Alchimy'—for, in the words of John French, it is pitty that such useful and so learned writings should be obscured from the English Nation'

JOHN READ

Homing among Animals

How Animals Find their Way About a Study of Distant Orientation and Place Recognition By Prof Étienne Rabaud Translated by I H Myers (International Library of Psychology, Philosophy and Scientific Method) Pp ix + 142 (London Kegan Paul and Co, Ltd New York Harcourt, Brace and Co, Inc, 1928) *7s 6d* net

DURING the present century the solution of the problem of 'homing,' or orientation from a distance, has come within sight, for backboneless animals at any rate, and the reason for the progress is to be found in the resolute use of experiment For bees and wasps it seems quite certain that they cannot find their way home unless they have had some experience of the locality, and unless hey can see well during their return flight Bees liberated on a lake near the hive do not return, unless by chance, for there are no landmarks to guide them The cues utilised by bees and wasps are visual, by following these they retrace the path they travelled in leaving the hive or nest But there is evidence that the cues are relations between objects rather than the objects themselves There seems to be a co ordination of clues into what might be called a synthetic impression—what would be in our case a mental picture, and there may be a successful bee line for the hive though various intermediate cues disappear

After many journeys the insect becomes more confident, it is even probable that muscular memory may be substituted for visual cues over a large part of the course When the bee is near the hive, olfactory, tactile, and perhaps other cues come into play But, according to Rabaud, the homing of flying Hymenoptera depends mainly on visual cues, and it is quite unnecessary to postulate any special sense of direction The experiments referred to convince one that this must be on the whole a sound conclusion

In the pedestrian ants the cues are more heterogeneous Olfactory hints are most important for those that travel in columns Visual cues intervene when the trail is accidentally destroyed

"As for isolated ants, they follow simultaneously visual cues of various kinds—light and large objects—closely associated, and connected in addition with features of the ground, notably with the slope Every cue is associated with all the others and also with the topographical position of the nest"

There seems to be a registration of the topography as a whole, for on the return journey the experienced ant may neglect roundabout paths and take short cuts In the course of time the return perhaps becomes a matter of kinæsthesis and appreciation of distance But, as in the case of bees there is no warrant for postulating any special sense of direction

Among the blind termites a trail is left by the troop and the cue is altogether olfactory If the path is swept, the termites are completely disoriented In limpets the return to the habitual position is mainly due to tactile cues For all invertebrates that show any homing,' the facts can be satisfactorily interpreted in terms of visual, olfactory, tactile, and baræsthetic or kinæsthetic cues

In regard to vertebrates, the conclusions are less secure, for fewer experiments have been made The most satisfactory data are in regard to carrier pigeons, but the case is complicated by the gradual training which the birds receive from man They can find their way home from a distance of several hundred miles, and when they did not themselves make the particular outward journey The evidence for a special magnetic or electromagnetic sensi-

tiveness is very dubious, the theory that the bird registers its outward journey in detail, and then retraces its steps, has to face the difficulty that the pigeons are often taken to a distance by train, Rabaud favours the view that the pigeons during their period of training acquire a considerable knowledge of places and utilise this experimentally on their return journey, even from a region not previously visited There are, however, some alleged returns on the part of untrained carriers, but these might be fortuitous

Against the possibility of homing without experience, it is perhaps enough to notice that in many cases the travellers from a great distance fail to return at all In 1895 five thousand pigeons were released at sea at varied distances west of Croisic The number of returns and the speed of the returns diminished with the distance and the altitude increased Out of 1500 pigeons released at 500 kilometres, 300 returned within forty eight hours—a sufficiently remarkable fact, the others were found scattered everywhere in England, Spain, Portugal, Algeria, at Cape Verde, in Egypt, and in the Caucasus Very significant is the fact that the return journey often takes far too long for the distance involved Thus eight pigeons, ignorant of the particular route, were transported from Antwerp to London

"Released at six o'clock in the morning, in fine weather, they turned about for a long time, and then flew off and had returned to Antwerp by seven in the evening, having taken thirteen hours to accomplish a journey normally requiring barely three"

This points strongly to the conclusion that whenever there is difficulty in the return journey, because of inexperience, absence of landmarks, bad weather, darkness, or the like, there is much tentative flying on the carrier pigeon's part The more the groping bird flies about, the greater is its chance of finding some cue

In the well known experiments made by Watson and Lashley on the terns nesting on the Tortugas, a percentage of birds returned from great distances, even of 800 miles, and from previously unvisited waters into which they had been transported in closed baskets on board ship But the successful return journeys took an unnecessarily long time

It is regrettable that the cases of homing on the part of domesticated animals, such as cats, dogs, horses, cattle, and sheep, remain at an anecdotal level "A cat taken by rail from Fife to Ayrshire was back again in two or three days", there are many such unprecise records, which should be tested experimentally There would certainly be some interesting result

Prof Rabaud has written a useful book on an interesting problem, and though, for our part, we should not wish to hurry to a conclusion, we admit that he has made out a strong case in favour of interpreting all homing in terms of a memory or registration of sensory cues His book is a good example of scientific scepticism and caution, and it badly punctures the hypothesis of a special sense of direction Yet when we think of the most recent experiments on homing bees, the average success of ordinary bird migration, and such striking cases as the return of a swallow from Africa to the Aberdeenshire farm steading where it was born the year before, the work of Watson and Lashley on terns, and the stories we have heard of homing cats, we are glad that Rabaud does not consider the question entirely solved

J A T

General Science for Schools

(1) *General Science (Mainly Chemistry and Biology)* By Dr E J Holmyard Pp xiii + 236 (London and Toronto J M Dent and Sons, Ltd New York E P Dutton and Co, n d) 4s

(2) *Everyday Science a Course of General Science related to Human Activities* By Dr L M Parsons Pp xi + 695 8s 6d Also in parts I, The Sky, the Earth, and Life II, Physics Man's Use of Motion III, Chemistry Man's Use of Matter 3s each (London Macmillan and Co, Ltd, 1929)

(3) *Junior Science* By C A Stebbins Pp xii + 352 (New York The Macmillan Co, 1928) 6s

(4) *Introductory Science for Botany Students* By K E Maris Pp vii + 181 (London John Murray, 1928) 3s

(5) *The Romance of Reality the Beauties and Mysteries of Modern Science* By Dr Beverly L Clarke Pp ix + 225 (New York The Macmillan Co, 1927) 10s net

(1) FOR years past, teachers have been saying that in the early stages science should be taught in a general way that historical treatment is desirable, and that the lessons should be of the object study sort It is to be hoped that they will like Dr Holmyard's book, for here they have it all presented in an ideal manner The author has excelled himself as historian and philologist, and the wine of his science teaching requires no bush His volume is intended as a second course, between an introduction and more formal study, but it is to be

feared that it may prove rather difficult at that stage For the sixth form boy who wishes to link up his science with history and with classical lore, and vice versa for the history and the classical specialist, it should suit perfectly Indeed, the science teacher himself who failed to derive pleasure from reading the pages would have to be either an exceptionally clever or an exceptionally dull person For this reason, if for no other, the book is to be commended to his notice

(2) Differing entirely from the foregoing in its method of treatment, the really excellent book which Dr L M Parsons has written should make an equally wide appeal It seems exactly suited to the general reader who desires a knowledge of the operations of natural phenomena or of the principles and applications of science Primarily the book is designed for students at school, but the author has avoided any suggestion of writing down to immature minds, and the work everywhere demands intelligence and concentration from the reader There are three parts, the first dealing with astronomy, geology and biology (including man), the second with physics, and the third with chemistry The last section, very naturally, makes rather more difficult reading than the other two, but throughout there is a singleness of aim and a lucidity of presentation which cannot fail to secure appreciation It may even do more and succeed in luring some of the rigid formalists among teachers from their straight and dusty paths

(3) As in the case of the two books previously mentioned, Mr C A Stebbins, though approaching the problem at a different angle, makes an attempt —and a good one—to instruct the young in natural science, through their interest in the things which surround them Devoting more space to the biological than to the physical aspects, the ground is reached through such pursuits as gardening and poultry farming The chapters on botanical subjects are exceptionally good, and contain useful descriptions of simple experiments on plant physiology This book also is to be commended for consideration by those who wish to get out of the usual rut in teaching science to beginners

(4) The intention of the author of the fourth book on our list is that it is to be studied as concurrent aid to a course in botany Although she is right in asserting that the usual text-book of elementary science is designed either as a preliminary to more advanced study of chemistry and physics or merely as an introduction to the subject with no definite end in view, her own aim has not always been very steady If her book is meant as an introduction to botany, much is included which might have been omitted, and on the other hand, it is not always of a sufficiently elementary character to serve as a 'first reader' We confess to a liking for books which have no ulterior end in view, and in our childhood that liking was even stronger It is so satisfying to feel—even if it is not true—that the book we are reading begins at the bottom and finishes at the top All of which is not to say that there are not many good things in the present book, for there are But the ideal school-book is one which can be read without help and gives the same sort of satisfaction as a dinner which has run through all its courses and has not stopped short at the fish

(5) Dr Beverly Clarke's purpose in writing differs from all those whose books have been mentioned above, for his immediate aim is, not so much to teach science as to show to those who are in outer darkness the beauties which can be revealed in the light of scientific knowledge In treating of many diverse themes, from protozoa to relativity, he manages to avoid mathematics entirely, and so has frequently to fall back on analogy for elucidation To the erudite this method may seem tedious and even unscientific, but doubtless it may help the unlearned, for whom he writes, to understand a little, and perhaps to marvel much

C L BRYANT

Quantum Mechanics

Materiewellen und Quantenmechanik eine elementare Einführung auf Grund der Theorien de Broglies, Schrödingers und Heisenbergs Von Prof Arthur Haas Pp vii + 160 (Leipzig Akademische Verlagsgesellschaft m b H, 1928) 7 50 gold marks

Wave Mechanics and the New Quantum Theory By Prof Arthur Haas Translated from the German edition "Materiewellen und Quantenmechanik" by L W Codd Pp xviii + 124 (London Constable and Co, Ltd, 1928) 7*s* 6*d* net

IT is now just three and a half years since quantum mechanics came into conscious being—or rather more than five years if we should date it back to the material waves of de Broglie The new theory has changed and expanded with such rapidity that even the bravest and most industrious writers have shrunk until now from the task of systematic exposition Now, however, books on the new theory begin to come to hand, and in the near future we may expect them in increasing numbers

Books which can properly be called books on quantum mechanics, or for that matter on any important new theory, are of three types (1) Systematic expositions which adopt a single consistent point of view and attempt, however imperfectly, whether in an elementary way or with elaborate mathematics, to develop the theory from that point of view as a logical whole, (2) reprints or translations of original papers by the main authors of the new theory, (3) books of an introductory or miscellaneous character, usually of the nature of, if not actually, courses of somewhat disconnected lectures Books of the first type are welcome in any numbers, however great The principal difficulty at the present stage is not how to use quantum mechanics but how to talk about it most intelligibly This is strikingly shown by the fact that many physicists, some of whom should know better, still speak of wave mechanics, matrix mechanics, and even the q number mechanics of Dirac as if they were three distinct theories instead of merely three different ways of trying to expound the same theory

It is likely that it is only by repeated attempts at systematic exposition that we shall achieve intellectual contentment about the new theory The first book of this type in point of time is Weyl's "Gruppentheorie und Quantenmechanik"—likely to remain for a long time to come a very notable example The great abstractness of its mathematical form is its outstanding feature and probably the main source of its more permanent importance But most of us, if we are honest with ourselves, though we may admit the importance of such abstractness, will admit, too, that we are as yet scarcely educated up to it The other book of the first type which has already appeared—Sommerfeld's "Wellenmechanischer Erganzungsband" to his "Atombau und Spektrallinien"—which expounds the theory systematically from the starting point of Schrödinger's wave equation—will prove to many of more immediate practical assistance We await with interest the many other systematic expositions of which there are rumours, confident that most of them will help to clarify our modes of thought and speech about atomic physics

Books of the second type of course tell us nothing new They are obviously a convenience to many students, especially in translation We welcome for this reason the recent publication of translations of the original papers of Schrödinger and of selected papers of Brillouin and de Broglie In spite of this convenience, however, it is questionable if there is not an element of danger to the student in the immediate publication of collected papers in book form A book is a much more imposing thing than a few offprints, and is liable to be given an authority which its contents do not warrant It is clear from his preface that no one is more fully alive to this danger than Schrödinger himself

Books of the third type may obviously range in value between very wide limits At their best they have very much of the nature of books of the second type, with the added advantage that the material has been worked through by another mind Birtwistle's "New Quantum Mechanics" is a book of this type, giving a convenient and faithful but uncritical reproduction of much of the earlier work on the theory Another better example is Haas's "Wave Mechanics and the New Quantum Theory," which in the original and in translation is the occasion for this essay This book is definitely not a systematic account of the new theory it is fairly elementary—would that it were systematic too! But it does give an excellent account of various disconnected aspects and applications The translation seems to be well done there are one or two obscurities due to failure to use the accepted English equivalent for a technical mathematical term, but they are not serious, and slips and misprints are very few It is likely to prove quite a useful book

R H F

Bushmen of the Central Kalahari

The Naron a Bushman Tribe of the Central Kalahari By D F Bleek (University of Cape Town Publications of the School of African Life and Language) Pp ix + 67 (Cambridge At the University Press, 1928) 6s net

ALTHOUGH the School of African Life and Language has been established in South Africa for a few years only, it has already accomplished much useful work in research It has now turned to publication It is appropriate that the first of a projected series of studies of South African tribes should be written by Miss Bleek, for, herself a distinguished authority, she worthily carries on the tradition of a name which will always be associated with the study of South African philology and ethnology Miss Bleek's book, apart from its intrinsic interest, is noteworthy in that it embodies material of a report of an investigation which was undertaken at the request of the Government It is gratifying to note this official recognition of the fact that these tribes present a problem which is worthy of scientific study

Miss Bleek classifies the Bushmen of the Kalahari

into northern, central, and southern The Naron constitute the central group. In structure and in the roots of the vocabulary their language shows affinities with the Nama tongue, but Miss Bleek considers that the differences are sufficient to warrant regarding them as two languages of one group, rather than as two dialects of one language This is not the only respect in which they show Hottentot influence It appears in their culture, in their religious belief, and in their physique Certain elements in culture and physique also show Bantu influence An obvious instance of the former is the custom of throwing the bones or dice as a method of divination in common use, but on a more elaborate system, among Bantu peoples of South and South Central Africa as a method of divination and witch finding It is evidently an importation among the Naron, for Miss Bleek says they seem to know very little about it

The religious beliefs of the Naron are confused and evidently composite Hottentot belief is clearly responsible for their hazy views of a supreme being, and Miss Bleek is more than probably correct in thinking that the original form of their religion was worship of the moon, which, by the way, as so often is regarded as masculine The medicine man, who is both magician and doctor, holds no special position Quarrels among medicine men lead to the use of 'grass arrows,' imitation arrows four or five inches long These, when thrown blunt end foremost, against the opponent's karos, cause death by magic

Miss Bleek's record is one of change, of disintegration, rather than degeneration, thanks perhaps to the fact that they have no intoxicating liquors, not even Kaffir beer They no longer have chiefs, though the older men remember them Originally nomad hunters, the game laws are forcing them to become vegetarians, though they retain their nomadic habits of wandering from water hole to water hole in small groups For they do not cultivate, and have no cattle Marriage was by capture, of which only a vestige remains The only regulation appears to be that brother and sister may not marry, and polygamy is permissible, though not general Of their mentality, Miss Bleek speaks favourably, also of their capacity for work It is clear that their extinction is by no means inevitable, given patient training, and a sympathetic understanding of their inability to endure long uninterrupted periods of employment, which would make it possible for them to supplement their present mode of subsistence, bound sooner or later to prove inadequate

The School of African Life and Language is to be congratulated on its first publication Such an excellent beginning should encourage some generous benefactor to supplement the funds, which are at present inadequate to meet the cost of publication on a more extensive scale

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Heat for Students

Heat and Thermodynamics By Dr J K Roberts Pp xvi + 454 (The Student's Physics, Vol 4) (London, Glasgow and Bombay Blackie and Son, Ltd, 1928) 30s net

AN advanced text book upon heat has been urgently needed Most of the literature available for honours students which dealt with the wide range of topics that are included under this title has either been too elementary or too specialised, and, in particular, it has been impossible to refer them to any good account in English of the many accurate experimental researches of recent years, whilst it is admittedly important that they should consult original papers occasionally, the pressure of preparation for examinations does not permit of extensive reading of this nature Dr Roberts's book fills the gap in a student's library that was present as a result of this state of affairs, and provides in a single volume a reasonably complete account of both the theoretical and experimental aspects of the subject

The first eleven chapters are mainly concerned with thermal measurements and such theoretical matters as are directly connected with them Thermometry, the properties of gases, calorimetry, thermal expansion, and the transfer of heat are dealt with more or less in the usual order, but with a range and detail that is new, and makes excellent reading Considerations of space have made it necessary to omit details of some important and accurate experiments that would find a place in a larger treatise, but Dr Roberts's choice of typical experiments of each class, based as it is upon his own experience at Teddington and elsewhere, is that of an expert It is satisfactory to find in this connexion that whilst most weight has naturally been given to recent work in which high precision was the objective, the classical researches of Andrews, Regnault, Rowland, and others have not been entirely ignored The work of Laby and Hercus on the mechanical equivalent of heat appeared too late for description in full, but the methods and results have been given in outline. The only important alteration that might be desired in these earlier chapters, in fact, is the pro-

vision of even fuller accounts than have been given of the properties of bodies at very low temperatures, and the ways in which they have been studied, the relevant original publications are scattered, and those emanating from Leyden, in particular, are not to be found in all science libraries

The remainder of the book is devoted to the more theoretical aspects of heat, thermodynamics being represented by seven chapters, and radiation and quantum theory by three The thermodynamics has been developed from the two fundamental laws, without recourse to the methods of statistical mechanics Certain sections are not given so fully as in Preston's "Theory of Heat," which could scarcely be improved upon for its treatment of general principles, but Dr Roberts has succeeded in presenting thermodynamics as a useful physical tool, and not as a mere branch of mathematics, more than fifty pages, for example, having been alloted to physical and chemical equilibrium and to the Nernst theorem

The section on the classical theory of radiation, again, is not developed with the rigour of M Planck's "Wärmestrahlung," the conception of rays being made more use of than that of cones of radiation, but there are complete proofs of the laws of Kirchhoff, Stefan, and Wien, the last being obtained by the help of Westphal's geometrical simplifications A derivation is also given of the formula for the number of independent vibrations of a continuous medium, whilst there is a chapter on power cycles, and one on the equation of state of solids, the latter being a good introduction to the work of Born, Debye, and Lennard-Jones in this field An appendix includes a short but useful list of thermodynamic relations, and a few pages on the properties of steam

It must be emphasised that this is essentially a text book, and that it is not intended for specialists It should, nevertheless, interest many who have left the days of examinations far behind them, and its value for these readers will be enhanced by the numerous foot note references to original papers With regard to its chief aim, it is very difficult to predict with any certainty whether or not any text book will appeal to students The writer has, however, already brought it to the notice of his classes, and so far as can be judged from the short time during which it has been in use, it fulfils its purpose admirably, there is every indication that Dr Roberts will have to be congratulated on having produced a book that can be recommended for examination purposes without an alternative

K G E.

British Ferro-Concrete Bridges

Reinforced Concrete Bridges the Practical Design of Modern Reinforced Concrete Bridges, including Notes on Temperature and Shrinkage Effects By W L Scott, assisted by C W J Spicer Second edition, enlarged Pp xii + 220 + 26 plates (London Crosby Lockwood and Son, 1928) 25s net

DURING the past decade a very great extension in the use and art of reinforced concrete construction has taken place Particularly is this the case in connexion with bridges, and the considerable number of important bridge structures of ferro concrete erected in Great Britain within recent years is significant of the activity of development Generally speaking, the employment of such forms was noticeable at an earlier date both in America and on the Continent, and the foreign literature on the subject is fairly extensive But the book before us probably represents the only volume published in Britain wholly devoted to the exposition of bridge design and construction in reinforced concrete As such it is both necessary and welcome

Reinforced concrete design developed along rather crude empirical lines at first, and under such conditions bridge construction in this material was somewhat tentative and not free from fears as to reliability Paradoxically, the destruction of bridges during the War provides the best proof of the inherent powers of resistance of this class of construction when well designed and soundly built, the difficulty of completely destroying them having been well demonstrated In first cost, probably the reinforced concrete bridge does not offer any great advantage over the steel structure, but in upkeep charges it is superior The present volume does not deal with costs, but it displays considerable power in the art of straightforward exposition of forms and design methods and it covers the range of suitable concrete bridge types very clearly

After chapters on rolling loads and influence lines, wind pressure and temperature effects, etc, which may be considered preliminary to the main theme, the author proceeds to discuss arch bridges and the elements of their design in detail The ferro-concrete type lends itself to the arch form of construction most appropriately, and has, indeed, been the chief cause of a considerable development in the theoretical bases of rigid arch design The book deals with both hinged and hingeless arches, but in the main the details of analysis are limited to the parabolic forms of these The author presumably considers the development adequate to cover the variations therefrom

A clear chapter is given on girder bridges and includes consideration of both the parapet girder and the deck slab and beam types. This is followed by a short chapter on the bowstring girder, which, as it has developed in reinforced concrete work, becomes a variant of the arch type, in which is incorporated a horizontal member suspended directly from the rib. The weakness, in reinforced concrete, of the diagonal shear members common in steel girders, is explained.

The remaining part of the book discusses temporary and permanent hinge construction and deals with the problems of foundations and abutments. The last chapter gives brief explanatory descriptions of several characteristic and important constructions. This includes an outline of the difficult and unique Oswald Street Bridge at Glasgow; but does not refer to the Royal Tweed Bridge at Berwick, the main span of which is the largest reinforced concrete span yet erected in Great Britain. There is an appendix dealing with specifications and materials. The diagrams throughout the book are noticeable for simplicity and clearness; while the many excellent photographs of bridges throughout the text and in the last chapter convey a very clear impression of the artistic effects achieved in modern reinforced concrete bridge design.

A New Spider Book

The Biology of Spiders. By Theodore H. Savory. (A Series of Biological Handbooks.) Pp. xx + 376 + 16 plates. (London: Sidgwick and Jackson, Ltd., 1928.) 16s. net.

MR. SAVORY has performed a useful task in collecting together into one volume the main facts of the biology of spiders. The ideal suggested in the preface, that the reader should have no need to look elsewhere for further information on the subject, was, of course, a counsel of perfection, but for most purposes the account is adequate. The student intending to embark on research—on eye structure, for example—will certainly not be content with the sketch here presented, but he will be greatly helped by an excellent bibliography, very conveniently arranged under appropriate headings.

About the section on external and internal structure little need be said. Mr. Savory is a competent zoologist in addition to being a very keen student of spiders, and his summary of morphological facts may be trusted, and will be found sufficiently complete. The illustrative figures are diagrammatic but generally to the point, though we are rather surprised that he should have passed Fig. 37 (p. 54); this is decidedly misleading as regards the œsophagus, which would appear to have no communication with the outside world. We turn with more interest to the subsequent bionomic sections, which the author justly claims to contain certain original contributions to what would otherwise be a mere compilation—useful though such a compilation might very well be.

The chapter on behaviour is interesting, and we commend the author's insistence at the outset on a cautious interpretation of the phenomena observed. The commonest mistake of naturalists is the attribution to the creatures they study of mental powers which they are far from possessing, and we are inclined to agree with Mr. Savory when, on a later page, he suggests that even such practised observers as Bristowe and Locket have somewhat erred in this respect in their interpretation of the phenomena presented by mating spiders.

The chapter on the spider's web is brief, and is chiefly interesting for the author's views on the origin and evolution of the more complicated snares. These views are of course speculative, but they are at all events reasonable. Naturally he starts from what he calls "the drag line habit," which would necessarily result in the coating of the retreat. The spread of this coating to the immediate neighbourhood would give the sheet web of *Tegenaria*, which Mr. Savory regards as the primitive type of snare, and the other forms appear to him to have arisen from the need to economise in silk.

Mr. Savory's account of protective coloration and mimicry gives, in a small space, all the important facts, and his acquaintance with current literature is shown by the inclusion of the interesting experiments of Gabritschevsky on changes of colour exhibited by *Misumena vatia*, published in 1927.

In dealing with mating habits, Mr. Savory of course alludes to the classic researches of the Peckhams on the antics of amorous jumping spiders, but he is chiefly concerned with the more recent observations of Gerhardt, Bristowe and Locket on other araneid families. We regard his discussion of these phenomena as among the most interesting and valuable portions of the work.

After reviewing the fossil spiders and the trap-door spiders, the author proceeds to consider the probable course of evolution of the whole order. He figures a hypothetical primitive spider and suggests lines of development resulting in the main divisions now recognised. A full discussion of his views would occupy more space than is at our dis-

posal Sufficient has been said to give a fair idea of the scope of the whole work

Mr Savory's style is clear, if his touch is not conspicuously light We rather regret his revival of the term 'spiderling' which used to irritate us in McCook, and we now and then find him employing an uncouth term What, for example, are 'Behaviourists'? The appendix on "Some other Arachnida" will be welcomed by certain of his readers, but we hope that when a new edition is called for, he will supply better figures to illustrate the ticks Those in the text are, not to put too fine a point upon it, atrocious C W

Birds of Malaya.

The Birds of the Malay Peninsula a General Account of the Birds inhabiting the Region from the Isthmus of Kra to Singapore with the Adjacent Islands By Herbert C Robinson (Issued by Authority of the Federated Malay States Government) Vol 2 *The Birds of the Hill Stations* Pp xii + 310 + 25 plates (London H F and G Witherby, 1928) 35s net

MR ROBINSON has produced his second volume on the birds of the Malay Peninsula with commendable speed, only one year having elapsed since the publication of the first volume, which contained the "Common Birds of the Malay Peninsula" The present contains descriptions of the "Birds of the Hill Stations," Mr Robinson having fixed a minimum level of 2500 feet for the purposes of his work

The title of the volume is perhaps a misnomer, for hill stations in the Malay States are still in their infancy, and the volume might have been called with greater accuracy "Birds of the Hill Ranges" The height of the majority of the main hill-ranges runs to some 7500 feet and, for the most part, they are covered with primitive forest but little cut up by villages and their cultivation, though intersected here and there by grassland and forest streams

In reviewing the first volume we have already expressed our regret that the author has been obliged to bring out his volumes in the form adopted The work has been divided into four parts In the first volume, as already mentioned, he dealt with the "Common Birds of the Malay Peninsula," whilst the two volumes still to come will include "Shore and Water Birds," the "Rarer Birds," etc Such a method of dealing with the avifauna of any country must necessitate an immense amount of unnecessary overlapping, which makes it very difficult for the would-be reader and student to find his way about in the different volumes In a vast area such as the Malay Peninsula, birds which are of great rarity in one part are common elsewhere, whilst many are restricted in their habitat to comparatively small areas and are absent elsewhere

In spite of this one great drawback, the present volume forms a most valuable, interesting, and well-written addition to our knowledge of the avifauna of the Malay Peninsula, and we congratulate its author on its production, which will fill a long-felt want The classification adopted is on the same lines as that for the past volume It commences with the game birds, continues with the pigeons, rails, raptores, and owls, and concludes with the Pico Passeres The author ignores orders and sub-orders and adopts the easier, and perhaps wiser, course of dividing his birds into families only On the other hand, he accepts a vast number of genera which are based on very slight characteristics Thus he resuscitates Hume's name *Athenoptera* for some of the Scops owls of the *spilocephalus* group, though these birds are almost indistinguishable from some members included by him in *Otus* In the circumstances it is perhaps discreet of the author not to attempt to explain to his readers the characters upon which he relies to distinguish his genera The 25 coloured plates by Gronvold are of their usual excellence and of a standard worthy of so important a work, the paper used for the text, however, is very heavy, and the large volume therefore somewhat inconvenient to handle

We are glad to see that Mr Robinson gives vernacular names to the great majority of forms with which he deals Many authors omit this important detail on the grounds that trivial names given by Orientals are of no value, as they refer only to classes and not to species of birds Most of them forget that these class names are nearly always amplified by prefixes descriptive of the particular species described

We shall look forward with pleasure to Mr Robinson's future volumes, which we feel sure will be of equal value to the present

Physics for Non-Specialist Students

Physics for College Students an Introduction to the Study of the Physical Sciences By Prof A A Knowlton Pp xix + 641 (New York McGraw-Hill Book Co, Inc, London McGraw-Hill Publishing Co, Ltd, 1928) 18s 9d net

PROF KNOWLTON'S text-book is an attempt to treat the subject matter of physics in such a way as to justify its study by students who do not

need it for future technical work but simply for its general educational value Having taught physics for twelve years in an engineering college where it required no justification, the author moved to an arts college and was then faced with the question Why should students study physics ? This book is an outcome of his attempts to present the efforts of man to systematise and master his physical environment, in such a way that the question is satisfactorily answered In order to do this, he has had, inevitably, to drop the usual more or less logical presentation of physics under separate headings of mechanics, heat, etc , and further, to add the necessary spice, he has included a good deal more of the 'new physics' than is the custom in such text books This entails leaving out certain portions, chiefly accounts of the older classical experiments, and methods of measurement, the latter being left to the laboratory course the book is thus kept a reasonable size , there are fifty chapters, each meant to be read comfortably at one sitting

The first chapter explains the place of physical science in modern civilisation and gives an excellent account of scientific method and attitude of mind and the distinction between facts and hypotheses Starting from the notion of 'work,' since "work is the most general and important article of commerce in the modern world," the author leads up to the concept of 'energy,' which is the central theme of the book This accounts for the early introduction of chapters on the measurement of energy in its various forms and on the connexion between matter and energy In the thirteenth chapter the sun is considered, as an introduction to the study of the sources and modes of distribution of energy, and this leads to the treatment of the motion of falling bodies, the production of motion, spectra, magnetic and electric fields, and atomic structure Then after wave motion comes radiation, leading up to X rays, relativity, and quantum theory The remaining fourteen chapters deal with the physics of the air, including sound, properties of matter, solid and fluid, some simple thermodynamics, and, finally, some more advanced magnetism and electricity with their practical applications

The obvious advantages of this method of presenting a subject like physics are that it enables students, after the first few chapters, to have a mental background against which further knowledge can be viewed, and it also allows what Prof Knowlton calls a cyclic arrangement, that is, a constant reiteration of fundamental facts and principles The attempt made throughout to utilise, in explanation, things familiar in everyday life is specially noticeable in the list of examples which follow each chapter, which are graded as to difficulty In fact, some of the problems are so attractive as to be almost irresistible, which is saying a good deal There are also timely paragraphs on scientific accuracy, measurement of quantities which vary irregularly, physical 'laws,' etc , and nowhere has true scientific caution been sacrificed to enthusiastic stimulation of interest The illustrations are good, especially the photographs in the optical section

Prof Knowlton has certainly succeeded in producing a text book which justifies its own study , and it is with no surprise that one learns that it has already met with "marked student approval"

Zoology for Indian Students

An Elementary Text Book of Zoology for Indian Students Adapted from "An Elementary Course of Practical Zoology," by Profs T J Parker and W N Parker Second edition By B L Bhatia Pp xii + 684 (London Macmillan and Co , Ltd , 1928) 15*s* net

SOME nine years ago the excellent "Elementary Course of Practical Zoology, by T J and W N Parker, was taken in hand by Mr B L Bhatia, of the Government College, Lahore, and adapted to the special needs of Indian students The book in its new form, entitled "An Elementary Text Book of Zoology for Indian Students," has now deservedly reached a second edition While the plan follows in general that of the Parkers' original book, it has been modified so as to make it less of a mere description of 'types' and more of a general text book

Part I , occupying about a third of the volume, remains as before—a description of the frog, forming an admirable introduction to vertebrate anatomy, histology, and physiology There are various improvements in detail, as, for example, in the figure of the frog's heart, which is still capable of improvement, as is also the account of the physiological action of the conus arteriosus

Part II shows more alteration A good account of the malarial parasite is given , the student is told how the mosquito "not only sucks blood but also spits into the wound," and his attention is further gripped by his being made to realise how India was the scene of Ross's original discoveries, and how practically important to India is the successful prevention of malarial disease

In the list of special types, various changes have been made to suit Indian conditions The earthworm is no longer the familiar *Lumbricus*, but the

Indian *Pheretima posthuma*, which, while in many respects equally suitable, suffers under the great disadvantage from the teacher's point of view that its nephridial organs are of extreme complexity and accordingly much less suitable than those of *Lumbricus* for driving home certain of the important general principles of the morphology and physiology of renal organs The crayfish of the Parkers' book is replaced by the prawn *Palæmon*, so far as external features are concerned, and the cockroach , while, as is entirely suitable, a short sketch is given of the life history of a mosquito The freshwater mussel as a type has been cut out, while on the other hand there have been added to the book chapters dealing with more general aspects of zoology The main groups of the animal kingdom are briefly reviewed, and the volume concludes with three chapters dealing with cytology, embryology, and evolution

Here and there are details which should be looked into when the next edition is being prepared—such as the references to 'true bone,' air bladder, and conus arteriosus of fish , and the absence of nephrostomes in the metanephros In the chapter on evolution there is still apparent the tendency to think in terms of organs or parts of organs instead of in terms of individual animals , while many teachers would regard it as an improvement to drop entirely the terms 'acquired character' and 'mutation'—the first because its use seems at once to cause confusion of thought in certain minds, the second because its use by different writers in different senses has caused it to lose its value as a precise scientific term

Apart from such minor blemishes in detail, the book is a thoroughly good one and may be warmly recommended to Indian teachers and students of zoology It is well illustrated, and the descriptions of the various animal types are accompanied by excellent directions for their practical investigation by the student

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A Bibliography of Bibliographies

Bibliography—Practical, Enumerative, Historical an Introductory Manual By Henry Bartlett Van Hoesen, with the collaboration of Frank Keller Walter Pp xv + 519 (New York and London Charles Scribner's Sons, 1928) *27s 6d* net

THIS work is based upon a series of lectures delivered annually at Princeton University since 1923 Its principal object is to train the graduate student in the use of bibliographies, and to inculcate the value of method in his practice The backbone of the work is a bibliographical appendix covering some eighty pages and enumerating more than two thousand bibliographies, and the first eleven chapters of this work are in the nature of a commentary upon the bibliographies listed

The authors rightly stress the fact that their manual is introductory rather than complete, and that their aim has been to set the student's feet on the right path of investigation rather than to load him with descriptions of all necessary material Within these limits we consider that the work has been carried out successfully The selection of bibliographies is judicious and singularly free from national bias, and the critical commentary proves that the authors are skilled craftsmen Omissions, of course, there are Archive searching should have been given a separate chapter, and the "Official Guide to the Public Record Office of Great Britain" should have been included Under 'technology,' again, we find an entry for the 'Catalogue of the German Patent Office," but none for that of the British Patent Office, or for its numerous 'Guides" and 'Subject Lists" A more serious defect is the weakness of Chapter ii on practical bibliography The nature of research is insufficiently explained, and the collection of bibliographical material and the rules for compiling bibliographies are treated together although the two subjects are entirely distinct Most collectors err on the side of false economy and pay for it in after life by having to recopy or remount their collections on paper of larger size The modern 'ringbooks' appear to offer one satisfactory solution of the problem

Again, the student should be warned against undertaking work for which he lacks the necessary technical equipment An engineering subject demands an engineering training Jenkins's 'Power Locomotion on the Highway," 1896, and Hopwood's "Living Pictures," 1899, are fair examples of successful bibliographical work by competent men The bibliographer should also be advised that, in whatever order he elects to publish his bibliography, he should at some period of its compilation sort his entries in chronological order and submit them afresh to critical examination , for chronological order solves many questions of authorship, priority of statement, and other bibliographical problems We think that in this chapter the authors have leaned too heavily upon outside opinions, which are often contradictory and far from helpful

The final chapters of this work are careful compilations of the histories of writing, printing, and book production They form interesting reading, but add little to the practical value of the work

Our Bookshelf

Archæology

Oraon Religion and Customs By Rai Bahadur Sarat Chandra Roy Pp xv + 418 + 20 plates (Ranchi *Man in India* Office, 1928) 12 rupees

ETHNOLOGISTS are indebted to Sarat Chandra Roy for his valuable book "The Oraons of Chota Nagpur" (1915), and now he has provided a study of Oraon religion and customs which should be read by all those who are interested in primitive religions The Oraons (or Kurukhs) are immigrants on to the plateau which they share with the aboriginal Mundas and other tribes

The especial value of this book is not merely in the detailed accounts of socio religious and religious rites and ceremonies and magical practices, but in the very suggestive religious transformations that have occurred since the Oraons arrived, and the process is still continuing The original religion centred round (1) the supreme spirit, or spirit of good, Dharmes, who was formerly the sun lord, the author, preserver, controller, and punisher of men, gods, and spirits, and (2) the 'evil eye' and 'evil mouth' as representing the spirit of evil Most of the village gods and spirits were appropriately borrowed from the Mundas, who had long been settled on the land, and a few have been borrowed from their Hindu neighbours There are also ancestor spirits whom the deceased Oraon joins on the annual 'great marriage' or 'bone drowning' day, apparently these were formerly considered to be mischievous, but now are mainly beneficent The most important annual ceremony is the spring festival of the 'marriage' of the village priest with his wife, in token of the marriage of the sun god with the earth goddess, so that the earth may fructify, probably it is a survival of a festival of the food gathering stage in their history The licentiousness permitted on this occasion is believed to stimulate the fertility of the earth

The germ of the Bhakti cults was very ancient, but under Hindu influence it was fructified as reverent faith in and loving adoration of a personal deity, thus was the way prepared for Christianity, which was introduced in 1845 Hindu organisations have tried to bring the Oraons into the official Hindu fold by giving them ceremonial purification, but with little effect

Chivalry a Series of Studies to illustrate its Historical Significance and Civilising Influence By Members of King's College, London Edited by Prof Edgar Prestage (The History of Civilisation Series) Pp xv + 231 + 24 plates (London Kegan Paul and Co, Ltd, New York Alfred A Knopf, 1928) 15s net

A VOLUME composed of a series of lectures delivered by a number of individuals must necessarily lack the unity of outlook of a book by a single author This is a serious defect in dealing with so important a factor in the history of western civilisation as chivalry However great an authority each of the authors whose lectures are included here may be on his special branch of the subject, the description of the characteristics of chivalry of countries—England, France, Spain, Portugal, and so on—misses the interpretation of the facts which is the function of a history of culture such as this series aims to be Hence apparent discrepancies in the attribution of chivalry as a characteristic outcome of the temperament of now one, now another, nation

A broader treatment would have brought out the fact that chivalry was an expression of the ideals, temperament, and culture of the Nordic peoples who had imposed themselves as rulers over a great part of Europe Hence the paradox of chivalry that its ideals prevailed within the caste only, and did not affect relations with the community, who, in fact, were a subject population Subject to this reservation, this book is an addition to the literature of chivalry which is to be valued, especially where it breaks new ground The illustrations, as nearly as possible contemporary, have been particularly well selected

The Ancient Wells, Springs, and Holy Wells of Gloucestershire their Legends, History, and Topography By R C Skyring Walters, Pp xiv + 194 + 62 plates (Bristol The St Stephen's Press, 1928) 12s 6d

GLOUCESTERSHIRE, owing to its geological formation, is a county exceptionally rich in springs and wells The remote character of much of its country side has tended to preserve the memory of the sacred character attributed to water by early man, which in modern times survives in the association of the well with a Christian saint In his descriptive account of the numerous sacred wells of Gloucestershire, Mr Walters, while constantly recognising that paganism lies at the root of the esteem in which the wells have been held, does not as a rule offer any suggestion as to the origin of the specific cults, or trace it further back than the dedicatory saint The custom of offering pins, rags, and coins to the well he attributes to the Romans, but the distribution of the custom in Great Britain and its prevalence in Ireland point to a more remote origin Mr Walters admits Wandswell as "at least one survival of paganism," the name being connected with Woden, but to speak of "Christian well worship" is a contradiction in terms unless Christian is used merely in a chronological sense

The Vampire his Kith and Kin By Montague Summers Pp xv + 356 + 8 plates (London Kegan Paul and Co, Ltd, 1928) 15s net

LIKE his books on witchcraft, Dr Summers' study of the vampire combines a vast erudition with a complete acceptance of the orthodox theological point of view Some knowledge of the history of

controversy relating to witchcraft and demonology is requisite in order that the reader may not dismiss the book as merely credulous and not, as it is, a real contribution to the literature of the subject Yet it may not be uninstructive to mention one minor matter which brings out clearly the author s point of view He accepts the real existence of the vampire That is a matter of authority He doubts that a nurse was in attendance when Bram Stoker s play ' Dracula " was presented in London Yet this was a statement of fact and could have been verified by inquiry If however the reader is prepared not to exact a scientific spirit of scepticism, Dr Summers' book will be found a mine of information relating not only to the vampire belief but also to the abnormal pathological states which without doubt gave rise to the belief—a gruesome but nevertheless instructive field of inquiry

Biology

Faune de France 18 *Diptères* (*Nématocères*) *Chironomidæ* III *Chironomarıæ* Par M Gœtghebuer Pp 174 32 francs 19 *Hyménoptères vespiformes*, II (*Eumenidæ*, *Vespidæ*, *Masaridæ*, *Bethylidæ*, *Dryinidæ*, *Embolemidæ*) Par L Berland Pp viii + 208 (Fédération française des Sociétés de Sciences naturelles Office central de Faunistique) (Paris Paul Lechevalier, 1928) 36 francs

The Faune de France ' series of monographs is now familiar to most zoologists and the separate parts already issued have been noticed at intervals in our columns The two most recent fascicules that have come to hand form Nos 18 and 19 in that series , No 18, by M M Gœtghebuer, is concerned with midges forming the tribe Chironomariæ of the family Chironomidæ, and No 19, by M L Berland, deals with the true wasps, together with certain related groups commonly united to form the family Bethylidæ The method of arrangement adopted in these two parts is similar to their predecessors , namely, a short introduction on structure and biology followed by generic keys under each genus is a key to the species, while each species is separately described, its general distribution indicated, and any important facts known relative to its biology are recorded The numerous illustrations and full bibliographic references are also noteworthy We commend these two monographs to the notice of English entomologists, since the French fauna includes most of the British species in the groups concerned A D I

Gilbert White Pioneer, Poet, and Stylist By Walter Johnson Pp xvi + 340 + 4 plates (London John Murray, 1928) 15s net

Many commentaries on the writings of Gilbert White have been published, but none has worked out in such detail the aspects seized upon in this volume In analysing the matter and the method of presentation of White s observations, the author has naturally lost the very essence of the attractiveness of the original works, but he has made a scientific appreciation which will be valued by those who would understand the place of these observations in the light of modern knowledge

The disconnected studies of " Selborne " and other works are here grouped and classified in their due relationship, ecology, birds, other vertebrates, insects, botany, geology, meteorology, and the like, and there are excellent chapters on the man, the scope of his work and the distinctive quality of his prose style Throughout the work the reader is brought in close touch with the meticulous observation glimpses of far seeing speculation, simple and clean cut phraseology, which have made ' Selborne the most widely read of Nature books The author claims that all the information of scientific value not previously printed from White's MS has now been transcribed and made public in this volume

Organographie der Pflanzen insbesondere der Archegoniaten und Samenpflanzen Von Prof Dr K von Goebel Teil 1 *Allgemeine Organographie* Dritte umgearbeitete Auflage Pp ix + 642 (Jena Gustav Fischer 1928) 30 gold marks

This new edition of the general section of a well known text book has increased considerably in size and the new material has not been simply interpolated, but the balance of the book has gradually changed with the maturing views of its veteran author as whole sections have been rewritten and reduced or increased in prominence The tendency seems still to be towards a stressing of the interrelationship of environment and organism during development This side of organ development receives much attention in the general introduction, and is the special subject of the last ninety pages The book remains an invaluable mine of information, especially upon experimental morphology The illustrations in the new edition have increased in number from 459 to 621, most of them the work of the author, his colleagues and students

Chemistry

Symbols and Formulæ in Chemistry an Historical Study By Prof R M Caven and Dr J A Cranston (Manuals of Pure and Applied Chemistry) Pp ix + 220 (London, Glasgow and Bombay Blackie and Son, Ltd , 1928) 15s net

Symbols and formulæ have been used incessantly from the early days of alchemy down to these modern times in which a radiating atom of sodium is represented by the scheme $^2S_{\frac{1}{2}} - {^2P_{\frac{1}{2}}}$ The title selected by the authors therefore provides them with a convenient excuse for drilling a bore hole through the whole of the strata in which the history of chemical theory is embedded The samples which they have extracted are naturally not the same as if they had been concerned with the general history of chemistry, and many obscure details are brought into the light of day , but the reader will find that the atomic and molecular theories the earlier and later theories of molecular structure, including stereochemistry and co ordination, fall

within the scope of the volume, as well as the modern electronic theory

The reader has thus an opportunity of taking an unfamiliar course through familiar fields of study, and will be well repaid for doing so It is a pity, however, that the cost of this sectional history is greater than that of a more comprehensive text book, since many readers who would purchase the latter will be content merely to borrow the former

T M L

Fixation of Atmospheric Nitrogen By Frank A Ernst (Industrial Chemical Monographs) Pp ix + 154 (London Chapman and Hall, Ltd , 1928) 12*s* 6*d* net

THE author of this book points out in the preface that it is not written for the scientific specialist, but "for the teacher and student, for the business man and banker " The book deals first with the sources of nitrogen and the need for its fixation from the atmosphere, and then considers in detail the arc process, the cyanamide process, the direct synthetic ammonia process, and ammonia conversion products The material is well presented, and is especially valuable on account of the full statistics given not only throughout the text and the chapter entitled "Statistics," but also in the tables at the end of the book A fair bibliography is also included The chapter dealing with ' Economic Considerations " indicates clearly a number of economic problems that arise in the commercial fixation of nitrogen At the beginning of Chapter ii (p 11) Bertholet is mentioned instead of Berthollet, and Sir Humphry Davy's name is spelt incorrectly No mention is made of MacDougall and Howles, who first worked the arc process in Manchester, and whose patent (1899) preceded that of Bradley and Lovejoy (1902), on the basis of which the author (p 12) claims that "the industrial fixation of nitrogen thus had its birth in the United States "

The Problem of Fermentation the Facts and Hypotheses By M Schoen With an Introduction by Prof A Fernbach A Monograph of the Institut Pasteur, translated from the French by H Lloyd Hind, and revised and enlarged by the Author Pp xii + 211 (London Chapman and Hall, Ltd , 1928) 21*s* net

THE author gives an interesting account of the present position of the problem of fermentation and traces its development from the time of Pasteur to the present day The whole range of the subject is covered alcoholic and lactic acid fermentation, the place of pyruvic acid and acetaldehyde in alcoholic fermentation, the function of phosphates and the effects of changing the reaction of the medium Analogous processes in animal tissues are frequently referred to, such as the function of lactic acid in muscular contraction or in malignant growths The references are given at the foot of each page and are also collected into a bibliography of some forty pages, which in addition serves as an index of authors' names This is a volume for the specialist, but should be widely read also by those interested in related subjects for the light it frequently sheds on processes which bear some analogy to alcoholic fermentation itself

The Determination of Hydrogen Ions an Elementary Treatise on Electrode, Indicator, and Supplementary Methods, with an Indexed Bibliography on Applications By Prof W Mansfield Clark Third edition Pp xvi + 717 (London Baillière, Tindall and Cox, 1928) 30*s* net

PROF CLARK'S standard work on the determination of hydrogen ions is too well known to require any introduction The third edition, recently issued, has been thoroughly revised and brought up to date The author points out that the number of papers on this subject has rapidly increased in recent years, so that, in spite of revision and enlargement, the work probably covers the field less completely than the first edition In spite of this, few except the advanced specialist will fail to find details required within its pages on the colorimetric or electrode methods of determination The subject is treated from both the practical and theoretical points of view, and forms a very complete treatise As the question of hydrogen ion activity enters into most biochemical problems to day, selected portions of the book will be of value to most biochemists and physiologists, and can be studied with profit There is an extensive bibliography and a list of definitions of common terms

Scent and All About It a Popular Account of the Science and Art of Perfumery By H Stanley Redgrove Pp viii + 100 (London William Heinemann (Medical Books), Ltd , 1928) 3*s* 6*d* net

THE careful reader of Mr Redgrove's booklet will gather many unusual items of information, such as the natural sources of ambergris, frankincense, opoponax (a name for perfumers to conjure with "), and civet He will notice that the civet used in Great Britain comes mainly from Abyssinia, packed in ox horns , that the odour of Jockey Club is that of the sweet wild flowers wafted over Epsom Downs , that diphenyl oxide develops an odour of geranium leaves only in dilute solution , that labdanum, the nearest approach to ambergris in the plant world, is gathered by shepherds from the fleeces of sheep which browse on the hills of Cyprus and Crete , and that the garden musk (*Mimulus moschatus*) of the present day has lost its odour, possibly owing to the fragrant plant of our ancestors having been a ' form ' which has since died out Within its modest limits this little book amply fulfils the author's purpose of providing the general reader with a popular account of the science and art of perfumery

J R

Inorganic Chemistry Vol 1 *Non Metals* By Dr G H Bailey and Dr D R Snellgrove Pp viii + 488 (London University Tutorial Press, Ltd , 1928) 6*s* 6*d*

THIS book, together with the companion volume, "Inorganic Chemistry Vol 2 Mainly Metals," is intended to cover the course for an intermediate

university examination, and is well produced for its price The style is clear and interesting, but a lack of original and more inspiring illustrations does not aid its favourable comparison with some other recent text books of similar character The statement is made on p 198 that the absorption of bromine vapour by iron filings produces ferrous bromide, $FeBr_2$, the compound formed is Fe_3Br_8, and is an important source of potassium bromide The paragraph on sulphur heptoxide, S_2O_7 (p 347), gives the impression that no further work has been carried out since Berthelot's supposed discovery in 1877

An Introduction to the Chemistry of Plant Products By Dr Paul Haas and Dr T G Hill Vol 1 *On the Nature and Significance of the Commoner Organic Compounds of Plants* Fourth edition Pp xvi + 530 (London, New York and Toronto Longmans, Green and Co , Ltd , 1928) 18*s* net

NOTWITHSTANDING the systematised courses in biochemistry which are now available in many centres, the new edition of this book will continue to subserve the authors' original aim of providing students of biology with an account of the chemistry and physiological significance of some of the more important substances occurring in the plant It contains sections on fats, oils, and waxes, aldehydes and alcohols, carbohydrates, glucosides, tannins, pigments, nitrogen bases, the colloidal state, proteins, and enzymes , there is also an appendix on hydrogen ion concentration It has been brought up to date, and although necessarily it contains a good deal of somewhat elementary matter, one may suggest that it could be read with profit by organic chemists who are wishful to view their subject from a biological outlook J R

Engineering

Foundations the Examination and Testing of the Ground preliminary to the Construction of Works—Methods and Appliances By William Simpson (The Glasgow Text books of Civil Engineering) Pp xviii + 256 (London Constable and Co , Ltd , 1928) 18*s* net

THIS book is the latest addition to the well known series of civil engineering text books produced under the general editorship of Prof Moncur, of the Royal Technical College, Glasgow Its scope is well indicated by the sub title It is wholly concerned with the study of the ground and of those methods of examination and test to be followed in the collection of essential data on which to base the design of the foundation arrangements for heavy structural work The first chapters deal with the features of geological surveys, and, indeed, the whole book gives a very clear impression of what the author refers to as "the intimate relationship which exists between Structural Geology and Civil Engineering" The development of the subject proceeds through a very complete discussion of boring and test shaft methods under all conditions, both on land and under water The final section provides a clear treatment of the procedure and appliances necessary for testing the bearing capacity of the ground by direct loading on open areas, and by test pile or exploratory tube methods in deep foundations

The book throughout is concerned with the practical problems, apparatus and operations of search There is no collection or classification of specific ground data but the care with which the detail appliances and methods are explained, the descriptive excellence of the text and the clearness of the diagrams, combine to make the book eminently suitable for students

Television By Alfred Dinsdale Second edition Pp xx + 180 + 33 plates (London Television Press, Ltd , 1928) 5*s* net

IN a foreword to this little book, Dr J A Fleming recommends it to those who desire an all round view of the art of television as it exists at present, and of the problems and difficulties which still face the inventors in this novel field of adventure We entirely agree with him He also points out that in all inventions like the telephone, radio telegraphy, and television, there are two stages of development First of all an idea strikes some one , then various people try to realise it in practice The next stage is when an inventor like a Bell, a Marconi, or a Baird, makes an invention or discovers a device, sometimes very simple, which opens up a new pathway, and then progress is rapid When the right clue is obtained, success follows, provided financial aid is forthcoming and systematic experiments are undertaken The history of the past furnishes many similar cases

The reader, even although his knowledge of physics is limited, will have little difficulty in understanding this book There is a great demand by the public for anything new, for anything which contributes to the convenience of life, to entertainment, and to the dissemination of instruction and news The physical importance of the new discoveries and inventions is considerable, and unlike many theories they are built on a sound experimental basis The great obstacles to radio television to great distances at present are the disturbances caused by fading, Morse signals, atmospherics, and all the other causes which mutilate the broadcasting of speech and music

A Text Book of Telegraphy Theoretical and Practical By A E Stone Pp vii + 455 (London Macmillan and Co , Ltd , 1928) 20*s* net

THIS book can be recommended to the student who has some previous electrotechnical knowledge He will find that it is easy to understand The descriptions of the apparatus and the systems in practical use can be readily grasped as only essential parts are shown in the diagrams Special attention has rightly been given to multiplex systems and to type-printing telegraphs Only the most modern methods are described Alternating currents, the transmission of signals, submarine and radio telegraphy, are all touched on and the main theorems in connexion with them are given The mathematical proofs in several

cases are novel, and to be commended We were unable, however, to follow the proof of the self induction of two parallel wires forming a loop (p 82) However, the answer given is correct, which is the main thing from the practical man's point of view The distinctions between the capacity of a condenser, the capacity of a conductor, and the capacity between two parallel wires, are not clearly explained In proving the formula for the latter, the assumption is made that the charges can be concentrated along the inverse lines of the two cylinders A proof of this should have been given As a rule, the symbols have been happily chosen On p 47, however, Z is used to denote a current, this use we think quite inadmissible On p 402 it denotes impedance, a use which has international sanction

Geography and Travel

Antarctica a Treatise on the Southern Continent By J Gordon Hayes Pp xv + 448 + 16 plates (London The Richards Press, Ltd, 1928) 42*s*

THE knowledge of Antarctic matters has grown at so great a rate during the twentieth century, owing to the intensive scientific exploration of several areas, that a comprehensive work bringing together in one volume the results achieved cannot fail to be of value This is part of the task that Mr Gordon Hayes has set himself In addition, he gives a critical estimate of the value of recent expeditions, and attempts some forecast of profitable lines of discovery Beyond all this there are a number of appendices, a bibliography, many excellent illustrations, and a few maps

There can be no doubt that Mr Gordon Hayes has brought industry and enthusiasm to his task, and though he has no personal experience of polar work, he has at least the advantage of being an impartial critic of all expeditions Yet it must be admitted that the book has several omissions and not a few inaccuracies, and falls far short of being a treatise on Antarctica Some of his criticisms, such as of transport by man haulage, are of value, but his strictures of the Wilkes expedition are somewhat severe, and his basis for judging the success of an expedition by the length of coast line discovered is most unscientific His list of casualties, which he calls the Antarctic Roll of Honour, is incomplete

It is on the scientific side, however, as apart from the record of discovery, that the book falls far short of its author's aim This is not surprising when it is realised from the author's list of works consulted that his material is derived mainly from the popular narratives of expeditions These are not designed to give the scientific results They are for popular reading Of the many volumes of scientific reports of recent expeditions, practically the only ones mentioned are those of the *Terra Nova* and a few papers on the work of the *Endurance* Moreover, there is almost entire omission of French and German works even of a popular nature If Mr Gordon Hayes does not make use of the available sources of material, he cannot claim to have written an authoritative treatise

The People of Tibet By Sir Charles Bell Pp xix + 319 + 57 plates (Oxford Clarendon Press, London Oxford University Press, 1928) 21*s* net

SIR CHARLES BELL has written a most interesting and very well illustrated book on the mode of life and domestic customs of the Tibetans which may be accepted as authoritative The shepherds and herdsmen are probably the purest specimens of the race The inclement conditions, especially hailstorms, render the peasants' life a hard one There is a great gulf between these classes and the nobility the trading community forms a middle class, but with little power, the foreign trade is in their hands, and even the nobility have their commercial agents, for the Tibetan is a born trader Begging is a hereditary profession, but the monks who go a begging are on a different footing There are few countries where women have so good a position, and they are active and shrewd in business matters Monogamy, polygyny, and polyandry are all found in Tibet, but on the whole monogamy is more prevalent

The daily life of the gentry is permeated with ceremonial and etiquette, and the usages of courtesy in all its branches are carefully taught to the young Many of the troubles of travellers here and elsewhere have been due to non observance of etiquette Tibet does not lack land fit for cultivation, but lacks the men to till it The population is decreasing owing to various causes, perhaps more especially to the large number that live celibate lives in monasteries instead of rearing families

Geology and Mineralogy

Kohlenpetrographisches Praktikum Von Dr Erich Stach (Sammlung naturwissenschaftlicher Praktika, Band 14) Pp iv + 196 (Berlin Gebrüder Borntraeger, 1928) 10 80 gold marks

DURING the last twenty years great progress has been made in the study of coal Instead of treating it only as a material which on combustion gave certain products, investigators have been studying the material itself, its constituents, their mode of occurrence and association, and their probable method of origin Coal is a rock rather than a mineral, and much of the progress that has been made has come from its examination by petrological methods These methods have been developed independently in England, America, and Germany, and their results have been described in many widely scattered publications, consequently a brief summary of the work with a full list of references is very valuable

The present work is probably more valuable as a survey of the field than as a practical handbook In the preparation of coal specimens for microscopical examination there are so many technical difficulties and so many 'tricks of the trade' that it is doubtful whether anyone could be sure of success by simply following descriptions of the methods employed But after describing methods, the author gives a brief but impartial statement of some of the results achieved, illustrated with many

excellent photographs, and followed by a bibliography of nearly 300 titles The book can therefore be used as an introduction to the subject

The author differs from most British coal petrologists in recognising only three chief constituents in bituminous coal He considers that there is no fundamental difference between the clarain and vitrain of Stopes and other authors He seems to favour the view that the characteristic bodies in Boghead coals probably represent algal colonies

Some omissions were probably necessary in a work of this type, but we notice no reference to methods of bleaching or reducing the colour of coal sections The work of Lilpop (Cracow, 1917) on this subject is worthy of mention

The book should help students in the early stages of research work on coal, and we ought to have many more workers on this subject in England

H Hamshaw Thomas

Bau und Bewegung der Gebirge in Nordamerika, Skandinavien, und Mitteleuropa Forschungen in den Jahren 1924 bis 1927, ausgeführt mit Unterstützung der Notgemeinschaft der Deutschen Wissenschaft Von Hans Cloos (Fortschritte der Geologie und Paläontologie, herausgegeben von Prof Dr W Soergel, Band 7, Heft 21) Pp viii + 241 327 + 6 Tafeln (Berlin Gebrüder Borntraeger, 1928) 14 gold marks

Those interested in theories of crustal drift will find much to their taste in this small work Prof Cloos extends his conceptions of 'granite tectonics' to cover block faulting and the like His personal observations and remarks on the granite tectonics of the Sierra Nevada, on block faulting in Europe and America, and on the structure of the Western States, are of permanent value, whatever may be the fate of his deductions from them

The theory advanced is that certain tectonics of the crust result from a world wide northward flow of subcrustal material against obstacles One expression of this appears in the wedge-form of the continents arising, as it were, from erosion by such a current Again, the structure of western America is explained by a south to north Pacific stream impinging on the continental margin Part of this stream is deflected to the north west, part passes beneath the continent, and both give rise to correlated tectonic effects Geologists who favour Wegener's continental drift theory would do well to compare it with these speculations of Cloos To one not particularly attracted by either hypothesis, the continents appear to be becoming embarrassingly mobile

The printing is excellent and the plates good, especially one showing the fault-plane of the Christiania trough

The Nomenclature of Petrology with References to Selected Literature By Prof Arthur Holmes Second edition Pp v + 284 (London Thomas Murby and Co , 1928) 7*s* 6*d* net

The second edition of Prof Holmes's extremely useful "Nomenclature of Petrology" is chiefly notable on account of its reduction in price from 12*s* 6*d* to 7*s* 6*d* This no doubt will be welcomed by students and research workers, who will find the volume a comprehensive and handy work of reference

While the author has made a few corrections and slight modifications, there still remain a few inaccuracies, and one still looks in vain for one or two well established terms During the eight years that have elapsed since the first edition, many new words have been introduced into petrological nomenclature The author points out that these are, for the most part, of minor importance Nevertheless, for this reason their usage is likely to be unfamiliar It is therefore regrettable that, on the score of the expense, it has not been found possible to incorporate them in the new edition The deficiencies of the book are trifling, however, and do not appreciably detract from its general utility

Medicine

The Blood Plasma in Health and Disease By Dr J W Pickering (Monographs on Medical and Surgical Science) Pp xi + 247 (London William Heinemann (Medical Books), Ltd , 1928) 12*s* 6*d* net

The author has performed a useful service in collecting within the pages of a single volume what is known about blood plasma as distinct from the formed elements of the blood Much has been written about the physiology and pathology of the different blood corpuscles, but the results of work on the plasma have heretofore remained scattered and uncorrelated In brief, this book treats of the composition of the plasma proteins and their relationship to each other, and of blood coagulation, the physiology of the process and how it can be aided or retarded, with the known pathological alterations in its mechanism

Upwards of 900 papers are referred to, and it is probably the brief accounts of these investigators' researches following each other in succession from page to page which makes the book rather difficult to read This is not to say that the author does not attempt to summarise the work quoted and to indicate what in his opinion is the most probable conclusion Thus the author's view of the process of blood coagulation may be briefly stated as follows Part of the prothrombin of the plasma is loosely bound, but the greater part is firmly bound, the various proteins being looked upon as a colloidal co ordinated complex rather than as separate fractions independent of each other The loosely bound prothrombin unites with protein-phospholipin (cephalin) complexes from disintegrated platelets, to form thrombin, which rapidly unites with fibrinogen, releasing the firmly bound prothrombin, to react further with cephalin He also considers that there are at least three methods by which plasma can be converted from a sol to a gel, and that it is a mistake to assume that one single process is always responsible for the formation of the fibrin clot

The theoretical aspects of the subject are made the basis of correlating our knowledge of the

pathology and treatment of abnormal bleeding, and a useful appendix is given of the composition and actions of, and indications for, a variety of commonly used hæmostatics The work will be of interest both to physiologists and clinicians, and further volumes in this series of monographs will be welcomed

On Rous, Leucotic, and Allied Tumours in the Fowl a Study in Malignancy By Dr J P McGowan Pp vii + 99 + 11 plates (London H K Lewis and Co, Ltd, 1928) 10s net

THE observations recorded by Dr McGowan in this book are a sequel to his study of pernicious anæmia and allied blood diseases, in the course of which he investigated leucosis of fowls and noted sporadic cases of sarcomatous tumour A detailed examination of these tumours and of the Rous sarcoma No 1 now lead up to a study of the etiology of malignant growths, with the conclusion that sarcomatous tumours of fowls, including those of a leucotic nature, are probably caused by various non-specific irritants Evidence is produced to support the thesis that these tumours are manifestations of disease of the hæmatopoietic tissues, the pathology of which is discussed in considerable detail

Whether the evidence justifies the author's conclusions must remain at present a matter for individual opinion, but whatever this may be, it will be agreed that careful research such as Dr McGowan describes cannot but assist in elucidating the problems of malignancy

Metallurgy

Impurities in Metals their Influence on Structure and Properties By Dr Colin J Smithells Pp xi + 157 + 23 plates (London Chapman and Hall, Ltd, 1928) 18s net

EXACT knowledge of the effects of impurities on the properties of metals is of fundamental importance to the metallurgist and engineer as well as to the physicist or chemist who uses metals as the subject of his researches There is, therefore, ample justification for the publication of a volume treating specifically this aspect of metallurgy Until the author took the subject in hand, no such book had been produced, but whether the present treatise is the one for which metallurgists have been unconsciously looking is quite another matter The author himself states that he would have preferred to use the term 'minor constituent' instead of impurity, and it is certainly very difficult to justify the application of the word 'impurity' to, for example, the large amount of chromium deliberately added to the stainless steels, to which addition in fact these materials owe entirely their characteristic properties

The effects of impurities on the mechanical properties of metals are quite inadequately treated Industrially, the most important metallurgical impurities are probably sulphur and phosphorus in iron and steel Of these, the former is dismissed in a few lines, and the latter scarcely mentioned From the historical point of view, too, one would have expected at least a brief reference to the pioneer researches of Roberts Austen and Arnold and Jefferson on the effects of impurities on copper and gold None of these workers is even mentioned

Although much interesting and useful information is made available in a handy form, the work leaves one with the impression that the range of the author's knowledge is too circumscribed to fit him for the task which he has undertaken The book as a whole is disappointing, and the subject still deserves and needs a far more complete and balanced treatment It is to the author's credit, however, that he had made us aware of the real need for a book treating as a whole the subject, some parts of which he has himself considered

Cast Iron in the Light of Recent Research By W H Hatfield Third edition, revised and enlarged Pp xv + 340 (London Charles Griffin and Co, Ltd, 1928) 16s net

IN spite of the extensive use of cast iron as a structural material, its scientific study has lagged conspicuously behind that of steel Until quite recently, the knowledge of its constitution has been almost entirely empirical, and success in its use has been due to the practical skill of foundrymen rather than to an understanding of the factors which determine its constitution Since the first edition of Dr Hatfield's book was published, there have been determined efforts to remove this reproach, but a careful compilation such as this brings out the fact that even now we are very imperfectly acquainted with the constitution of cast iron, and therefore with the means of scientific control of its properties For example, the relations between the sulphur and manganese contents of the iron are of the greatest importance in determining the degree of chill under given conditions, but the evidence is contradictory, and published work on the subject goes little beyond the knowledge of practical foundrymen Even the relations between graphite, combined carbon, and silicon cannot yet be represented in a simple and intelligible diagram, and arbitrary assumptions have to be made concerning them

Dr Hatfield has included almost all that has been done on the subject, except in regard to the so called 'pearlitic' irons, which might have received fuller treatment, and the new edition is valuable as a work of reference on a much neglected field of metallurgy Unfortunately, the references in the foot notes are frequently incorrect, probably through imperfect proof reading, and the student who attempts to consult original papers may find himself at a loss Apart from this defect, however, the book is to be commended to metallurgists as a compendium of facts When the fourth edition is called for, it may be hoped that such progress will have been made in the scientific knowledge of cast iron that a systematic presentation of its metallography is possible

C H D

A Bibliography of Metallic Corrosion comprising References to Papers on Ferrous and Non-Ferrous Corrosion (including Methods of Protection) published up to end of 1927 Greatly enlarged from a Bibliography prepared for the British Non Ferrous Metals Research Association and privately issued to its Members By Dr W H J Vernon Pp xi + 341 (London Edward Arnold and Co, 1928) 21*s* net

THE literature of corrosion is extensive and at the same time widely scattered, so that a student of the subject feels the need of a bibliography more than in most branches of applied physical chemistry Several attempts at such a compilation have been made, but certainly with less success than in the present work, which is likely to prove of great value to chemists and to metallurgists At first sight it may be thought that the classification which Dr Vernon has adopted is not the simplest, since there is no alphabetical index of authors, and the arrangement is one of many sections, each of which covers a definite part of the subject After using the book for a short time, however, it is found that there is no difficulty in tracing any required paper the author of which is known, whilst a thorough system of cross references ensures that the papers likely to have a bearing on any particular question can be traced with little effort The bibliography has responded well to the test of looking for known memoirs

There is no attempt to give the exact title of each paper, a short indication of the subject being given in English, but the original reference is accompanied by references to abstracts in the most accessible English and American journals When necessary, a brief abstract is added, and this part of the work has been done judiciously, so that the reader is guided to essential papers without having to consult a large mass of material of no importance to his immediate subject Dr Vernon is to be congratulated on having performed a useful task with success

C H D

Miscellany

History and Historical Research By C G Crump Pp x + 178 (London George Routledge and Sons, Ltd, 1928) 5*s* net

THIS is a delightful and stimulating little book Mr Crump held an important position in the Public Record Office for many years, but he writes in a spirit which would be equally becoming in a scientific laboratory In fact, his essay is one of the best proofs we have seen of the essential similarity between all forms of work which aim at increasing knowledge of a living kind Almost everything he says might be said with equal truth about scientific research

Mr Crump starts with the primary and fundamental necessity of an inquiring mind Every researcher must be possessed with the desire to know In this he only shares the characteristic which Aristotle assigned to the human species as a whole, when he adds to this the mark of wanting to know something new, or more about something than anyone else knows, he takes rank among original researchers—those who add to the sum of human knowledge But in order to do this he must at starting be provided with a considerable equipment of general knowledge, and no part of Mr Crump's book is better than where he dwells on the supreme importance of a well trained mind in judging of the likely field for research and of the value of evidence, and in presenting it in a lucid and well ordered form

Two other admirable features stand out in this manual for the young researcher One is the insistence on self reliance The choice of subject must be individual, and the professor, or older and more experienced colleague, should assist as friend and equal, not as dictator or superior All the details of his method—the note taking, and arrangement, the planning and writing of the book—will be subordinate to the main idea, and grow under his hand as he works In short, the researcher, be he historian or man of science, is master of his own fate, and no one can make or mar it but himself

Another attractive feature of the book is the style in which it is written, and the constant quiet humour which irradiates the whole There is no better example of this than the analogy of the choice of a subject with the chase of a lion The researcher has first to delimit the area in which he may find his quarry This in itself demands wide knowledge and careful preliminary survey by these the true haunts of the subject are ascertained The searcher then advances, slowly and steadily testing and securing all the means of approach, and when at last the noble object of his quest stands before him, he is just as likely to be devoured by the quarry as to make it his own The former indeed may seem as fine and fitting a reward as the latter

F S M

The Evolution and Classification of Soils By Dr E Ramann Translated by Dr C L Whittles Pp xii + 127 (Cambridge W Heffer and Sons, Ltd, London Simpkin Marshall, Ltd, 1928) 7*s* 6*d* net

STARTING with a definition of soil, the author brings together many of the ideas and systems which have been developed throughout the world for its scientific classification After discussing briefly the advantages and disadvantages of various methods of classifying soils, a system is adopted which, although almost too wide for general use, is not subject to the serious limitations of most of the older classifications A soil is classified in accordance with its 'zone' (latitude and longitude) and its 'region' (depending on height, position, humid or arid climate, etc)

Most soil workers nowadays have a little knowledge of the Russian pedological classifications and nomenclature, and this has proved in many cases a dangerous thing Those who want to know the exact meaning of *podsol*, *tschernosem*, and similar terms frequently used and mis used in recent works

on soils will find an excellent discussion on the subject in this book, although the author wisely avoids too drastic a use of modern Russian systems Soils are but short lived things compared with their geological neighbours, and our knowledge of their characteristics in bygone times is still scanty—but the paragraph on "Relic Soils" whets our appetite for more

The translation, in spite of great difficulties, reads easily Only one slight improvement might well have been made, it would have been better to have anglicised the transliteration of Russian names—the German transliterations offend the eye in an English book and are very apt to be mis leading

The Great Betrayal (*La Trahison des clercs*) By Julien Benda Translated by Richard Aldington Pp x + 188 (London George Routledge and Sons, Ltd, 1928) 7*s* 6*d* net

THE thesis of M Benda's book is that the European *intelligentsia* have gone over to the enemy, that is to say, they have deserted the idealist ranks and joined the great army of the Philistines It is not merely that the *intelligentsia* have become sceptics they have actually transferred their allegiance, and devote themselves to detract and deride every form of idealism For example, they lend themselves to "the intellectual organisation of political hatreds," and preach the doctrine of "sacred egotism" They display "the scorn for argument, the excess, the hatred, the fixed ideas" which we are ac customed to associate with the lowest forms of political propaganda In short, they have pros tituted their powers, and have become the militia of materialism Even internationalism, which assumes imposing idealist airs, is inspired by bankers, industrialists, and trade unionists, whose aims are by no means disinterested

The most notable betrayal has been an attack upon the intellectual ideal of truth itself, since "truth is a great impediment" There is now, for example, "a bourgeois truth and a working-class truth," and truth varies with frontiers "Recently certain French thinkers waxed indignant that the doctrines of Einstein were accepted by their com patriots without more resistance" There is doubt less much ground for M Benda's onslaught in some continental countries But we do not think that British men of letters or of science have yet reached this stage of cynical barbarism Yet the book is well worth reading The translation is good

J C H

Physics.

Modern Physics By Prof H A Wilson (The Student's Physics, Vol 6) Pp xiv + 381 (London, Glasgow and Bombay Blackie and Son, Ltd, 1928) 30*s* net

PROF H A WILSON is best known for his experi mental researches, but this book shows that he is also able to give clear expositions of the more theoretical aspects of modern physics As he has himself recognised, the title is elastic, and not every-one will agree with his interpretation of it In particular, most examinations demand a greater knowledge of the newer experimental methods and less of mathematical physics than is given here The outlines of electromagnetic theory and electron theory are especially good, and furnish an excellent introduction to more pretentious treatises, whilst the two chapters on relativity are complete in them-selves The sections on the conduction of elec-tricity through gases are good so far as they go, especially the chapter on flames, but too great weight has been given to the work of the Oxford school, and the treatment of the glow discharge could well have been entirely replaced by an account of the precise methods for studying ionised gases at low pressures that have been developed in the last few years at Schenectady and at Princeton, the potentialities of which have still to be properly recognised

The same general criticism applies to the other parts of the book that have an experimental bias What is given is, nevertheless, concise and accurate We have noticed only one incorrect statement the photographing of the artificial disintegration of a nitrogen nucleus is erroneously attributed to Chad-wick in the text (p 225), an obvious slip, since the proper acknowledgment is made to Blackett on the corresponding plate (p 131)

An Introduction to Physical Science By Dr Ivor B Hart Second edition Pp xii + 406 (Oxford Clarendon Press, London Oxford University Press, 1928) 4*s*

An Introduction to Physical Science By Prof James Rice (Benn's Sixpenny Library, No 115) Pp 79 (London Ernest Benn, Ltd, 1928) 6*d*

THOUGH of the same title, these two books differ widely in treatment and in aim The former, now in its second edition, has already proved useful for beginners in experimental science Mechanics, heat, light, sound, and magnetism and electricity all find a place in its pages, the young student being introduced to these sections in some fifty experi-ments which he is himself to work through De-scriptions of numerous demonstrations and appli-cations are also included, the whole being put together in a perfectly natural manner which cannot fail to attract The arrangement is ex-cellent, and the book is cheap at the price

Prof James Rice's book reads more like a retro-spect than an introduction To comment ade-quately on all the main branches of physics within seventy small pages requires very close packing We cannot help feeling that the little book would demand a greater effort of concentration than the majority of uninstructed laymen would be willing or able to make It does, however, provide a pleasant evening's reading for one who already knows, and it might with advantage be put into the hands of students at about the intermediate stage, for the purpose of providing a general survey of past work

An Introduction to Advanced Heat By Dr Ivor B Hart (Bell's Natural Science Series) Pp vii + 336 (London G Bell and Sons, Ltd, 1928) 7s

THE title of this book has been chosen to indicate a standard beyond that usually reached in schools but somewhat below that expected of candidates for the highest honours in the first university degrees The author assumes that his readers really know their elementary work, and even so they must draw a deep breath before plunging into the first chapter, which deals fully with the various scales of temperature

Avoiding the snare of descriptive writing, the author sticks rigidly to his purpose of developing the theory of the subject until he has dealt adequately with the expansion of gases, both from the kinetic and the thermodynamic points of view All this makes rather stiff reading but the conscientious student can scarcely fail to have the satisfactory feeling that he is really plumbing the depths of his subject He will find himself rewarded, at the end, by some more readable chapters, of which perhaps the best—certainly the most novel—is one relating to convection in the atmosphere

Dr Ivor Hart has already achieved prominence as a writer of more elementary books and as a biographer In this latest excursion he is likely to be equally successful

Intermediate Electricity and Magnetism By Dr R A Houstoun Pp x + 170 (London Longmans, Green and Co, Ltd, 1928) 4s 6d

THE title clearly indicates the scope of this book Although it is written on conventional lines, there are many points in the arrangement which make for the orderly development of the subject in a student's mind, the sequence of the reading being unbroken by tedious descriptions of experiments and by reiteration in applications and examples By concentrating in the earlier portion of the book upon the elucidation of main principles, the author has removed from the pupil the difficulty of sorting out the grain from the chaff—it is all good stuff The technical applications of electricity, radio activity, and 'wireless' are reserved for the end of the volume, after the fundamental ideas have already been formed A good collection of questions and examples, inconspicuously printed, help to make up a really useful book

An Outline of Physics By Prof A E Caswell Pp xiv + 773 (New York The Macmillan Co, 1928) 18s net

THIS book is an elementary introduction to physics which is very pleasant to read It is written to appeal to non-mathematical students and to all who are willing to show a passing interest in physics The conceptions necessary to modern physics appear quite early in its pages, and by gradual stages the reader is introduced to many of the most striking and most important results of modern research Analogies are given freely—perhaps too freely, it may be felt, in one or two instances, but the author is always clear, and his final chapter, on the theory of relativity, is exceptionally well written

War Office Elementary Notes on Optics and their Application to Service Instruments Compiled for Use in the Rangefinding Branch, Military College of Science, Woolwich, 1927 Pp 128 (London H M Stationery Office, 1927) 3s net

A USEFUL little book which should fulfil its purpose very well, and give the military student of optics the guidance he needs in understanding the construction of his instruments It may be suggested that the treatment of simple lenses is a little brief, a fuller discussion of the magnification at various conjugate distances would have been valuable when dealing with variable power telescopes Also, in spite of the limitations of space, a few remarks on spectacles and on colour filters would have been useful to the service student

Primary Physical Science By William R Bower Pp ix + 302 (London Sir Isaac Pitman and Sons, Ltd, 1928) 5s

THE book deals with the rudiments of mechanics, heat, and chemistry along the lines laid down for the examination in preliminary technical science of the Union of Lancashire and Cheshire Institutions For the most part the treatment is conventional but good historical and biological notes are included The book suffers from a certain lack of continuity in the reading, as is almost inevitable when a work serves the purpose of a laboratory manual, a text book, a history of science, and a book of exercises, all in one

Laboratory Physics a Short Course By H W Heckstall Smith and B A Fletcher Pp vii + 224 (Oxford Clarendon Press, London Oxford University Press, 1928) 4s 6d

THIS book is intended for use in all the laboratory work in physics which is necessary for the higher certificate examinations Although there is little that is novel in the experiments which are described, the whole book is excellently arranged and it should tend towards good, orderly work in a school laboratory It would also serve as a useful guide in any school where an advanced course in science is being developed

Physiology

A Text book of Physiology By Prof William D Zoethout Third edition Pp 664 (London Henry Kimpton, 1928) 18s net

Laboratory Experiments in Physiology By Prof W D. Zoethout Pp 251 (London Henry Kimpton, 1928) 10s 6d net

THESE two books may be considered as complementary In the text book the author has set out to give an account of physiology suitable for dental students, and has attempted to steer his course between the larger text-books and the shorter elementary treatises The work has reached its third edition in the course of a decade and has been thoroughly revised, it appears to be well up to date The selection of material for such a book must be largely a matter of opinion, and depends in part on the courses required of the

students for whom it is intended, it may be recommended to all those who do not wish to read one of the larger works

The other volume gives a fairly detailed account of experimental class physiology, including also a short section on chemical physiology The experiments, however, are often unsuitable for a practical course in Great Britain, since they require the use of anæsthetised animals as subjects, some, doubtless, with suitable modifications could be carried out on the surviving carcass Apart from this objection, the experiments described appear to cover the ground fairly completely and are probably more detailed than required by the average medical student A number of the illustrations are taken from Jackson's "Experimental Pharmacology"

The A B C of Vitamins By John Pryde (The Vanguard Series) Pp 128 (London John Hamilton, Ltd, 1928) 2*s* 6*d* net

THE aim of this short readable volume is to give the non scientific reader a simple account of our present knowledge of the vitamins in non technical language The author appears to have succeeded very well in conveying the essentials of a complex subject to its pages, and the book should enable the numerous people who take an interest in their diet to choose appropriate foodstuffs or to exercise discrimination in their selection of a proprietary 'vitamin food' We note that the author refers to vitamin B_2 as the growth promoting fraction of vitamin B, as a matter of fact, animals, young rats for example, will fail to grow unless vitamin B_1 is supplied in the diet as well as vitamin B_2, so that both fractions are necessary for growth Also it is stated that mammalian liver contains vitamins A and D it appears probable that the latter is absent from mammalian liver, although fish livers provide a rich source of this vitamin These criticisms, however, detract in no way from the usefulness of the book to those who wish to regulate their diet, but people should not be advised to give themselves ultra violet irradiation in their own homes, owing to the dangers of possible over exposure The book is quickly read and can be recommended to the intelligent layman for perusal

Übungen aus der vergleichenden Physiologie Atmung, Verdauung, Blut, Stoffwechsel, Kreislauf, Nervenmuskelsystem Von Hermann J Jordan Unter Mitwirkung von G Chr Hirsch Pp viii + 272 (Berlin Julius Springer, 1927) 18 gold marks

THIS manual gives the course of laboratory exercises in comparative physiology which the authors have evolved for students of biology in their laboratory at Utrecht Experiments have been selected which are readily performed by the student and require only easily obtainable biological specimens and apparatus, wherever possible, of a simple rather than of a costly character The book deserves the attention of zoologists, since it is primarily biological and not merely an adaptation of medical physiology

Psychology

An Historical Introduction to Modern Psychology By Dr Gardner Murphy With a Supplement by Dr Heinrich Klüver (International Library of Psychology, Philosophy, and Scientific Method) Pp xvii + 470 (London Kegan Paul and Co, Ltd, New York Harcourt, Brace and Co, Inc, 1928) 21*s* net

A PRELIMINARY glance at this very substantial volume—one of the largest in the important series to which it belongs—might cause one to wonder at certain of its features Why, for example, should several pages be devoted to Alexander Bain, and only a few words to James Ward? The answer to this question reveals one of the many limitations which the unquestionably learned author has imposed upon himself Bain stood strongly for the physiological approach, whereas Ward's contribution, though equally distinctive, consisted in applying evolutionary concepts to introspective analysis, and Dr Murphy's main concern is to trace the changes which have led to an increasing emphasis upon the objective method of study, which has passed from the physiological to the experimental and quantitative methods so assiduously cultivated to day It is for this reason that such a thinker as Ward does not come much into Dr Murphy's picture The author has provided a most interesting and satisfying account of modern psychological developments in Europe and America In a supplement, Dr Kluver shows how recent German psychology has proceeded on lines of its own

Practice Fatigue and Oscillation a Study of Work at High Pressure By J C Flügel (*British Journal of Psychology*, Monograph Supplements, 13) Pp v + 92 (Cambridge At the University Press, 1928) 8*s* 6*d* net

THIS is the latest addition to the series of monograph supplements issued in connexion with the *British Journal of Psychology*, and is a good example of the kind of work which is being done by the scientific or objective school of psychologists at the present time—a school which has found great favour in America, but less in Great Britain 'Fatigue' and 'practice,' and the relations between them, are familiar subjects of experimental investigation By 'oscillation' is meant those short period variations in efficiency usually referred to as fluctuations of attention

Mr Flügel's object has been to experiment, on a larger scale than has hitherto been attempted, with the view of discovering any general characteristics of these three functions, and also to apply statistical methods to the study of their inter-relationships The thoroughness of his procedure, the extreme caution with which inferences are drawn, and the frank admission, or rather insistence, that complete success was not achieved in carrying out a rather ambitious programme, are all in the most exacting spirit of scientific method It is on such studies as these that an important group of modern psychologists have hopes of real advance

The Child in Primitive Society By Prof Nathan Miller (Library of Educational Psychology) Pp v+307 (London Kegan Paul and Co, Ltd, 1928) 12s 6d net

THE scientific study of childhood assumes several different aspects, of which the physiological and the psychological have received much attention for several decades past The sociological study of the child has not come so definitely to the front, although A F Chamberlain's book, "The Child a Study in the Evolution of Man," stands as a good specimen of what could be done in this field a generation ago Dr Nathan Miller's is a timely addition to contemporary literature on the subject

For the educator the value of the work before us lies in the fact that the position of the child in a modern complex society is made clearer by an examination of the part he plays in primitive society From the broad scientific view such a study is of value because of the light it throws upon the mechanism of social heredity, for in the absence of a written language the child has necessarily been the chief means of perpetuating culture from one generation to another Dr Miller has used the method employed by Spencer, Frazer, Tylor, and others—the method of drawing upon the immense body of facts collected by trained observers, and by travellers among people of simple cultures A most interesting and stimulating treatise is fortified by an extensive bibliography

Technology

Practical Color Simplified a Handbook on Lacquering, Enameling, Coloring, and Painting, with special attention to Mixing, Choosing, Harmonising, Matching, Lighting, Testing, and Designation By William J Miskelle (Practical Finishing Series, Vol 1) Pp xiii + 113 + 10 plates (Chicago Finishing Research Laboratories, Inc, 1928) n p

THIS book sets out to provide a guide to a great many problems for the practical colourist, but in spite of its somewhat ambitious presentation of a colour circle, mixing triangle, harmonising triangle, and so on, there will be little to be gathered beyond the usual elementary facts of subtractive colour mixture that could not be very much more effectively learned by a really scientific approach to the subject Arbitrary directions to mix so many parts of 'red' with so much 'blue' are apt to be misleading unless the mixer knows something about the red and blue to select A knowledge of the spectral transmission or reflective coefficients of pigments, some notions of their relative staining powers, and the like, would form a very much sounder basis on which to build a discussion of real colour mixture

The writer brings in some discussion of 'wavelengths' (he should note that μ stands for one micron, *not* a milli micron) and has something to say on nearly everything from 'Shakespeare' to 'Old Glory,' but when in his chapter on "Colour Photography" (which ought to be headed "The Photography of Colours") he laments that "panchromatic plates are not generally available for the use of either roll film cameras or the amateur photographer," he must be prepared to make readers of NATURE somewhat nervous of his leadership The book may be of some help to those who are prepared to accept his interesting methods of selecting colour harmonies

Photographic Art Secrets with a General Discussion of Processes By Dr Wallace Nutting Pp x + 133 + 105 plates (London Chapman and Hall, Ltd, n d) 12s 6d net

'THE author has made many millions of photographs," although he confirms the statement that "there are only two perfect photographic days in the year," and in this volume gives his experiences in a series of ejaculatory statements of facts and opinions, but unfortunately does not distinguish between the two He acknowledges that his *secrets* "may not be secrets to all who use cameras," but finds that the average amateur photographer does not know, or at least does not use his knowledge, of these matters Scientific facts given are very few, this side of the art being evidently weak with the author, for example, he says 'a plate consists of microscopic particles of nitrate of silver in an emulsion of gelatine" The author condemns exposure meters as requiring judgment in their use, 'bothersome also because to consult it requires time," and 'it is often impossible to use" Instead, he gives a table of proportional exposures according to the time of day and year, climatic conditions, and the character of the subject We cannot indicate all the topics dealt with, as there are forty two of them, these and the numerous illustrations, many of which are very nice and bear evidence to the author's skill, form a book that contains many useful suggestions that will inform the ignorant and refresh the memory of others

The Finishing of Jute and Linen Fabrics By Thomas Woodhouse Pp xxi + 346 (London Macmillan and Co, Ltd, 1928) 18s net

THE second edition of this standard work, which was originally published at 8s 6d, now makes its appearance at a considerably increased price Unfortunately, a careful comparison of the new and old texts does not reveal as much new treatment of the original subject matter as one is led to expect from the preface Nevertheless, several new features appear in connexion with recent developments in the various kinds of machines which are described, particularly in the case of bag sewing machines References are made to modern applications of electric driving and heating, to safety devices, and to improved methods of mechanical adjustment In addition, the chapter on waterproofing and fireproofing has been almost completely rewritten

The author's work is usually characterised by excellent diagrams and illustrations, and this book is no exception

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neglected by Dalton The formulæ used by Higgins are also more related to modern formulæ than were those of Dalton

SIR ERNEST RUTHERFORD delivered the first of a course of four lectures on "Molecular Motions in Rarefied Gases" on Mar 2 at the Royal Institution. In recent years, much experimental work has been done in this interesting field of inquiry, and the results obtained are not only of theoretical importance but also of practical and industrial interest, as the construction and operation of high speed pumps for production of the lowest vacua and the measurement of the minute pressures depend on an accurate knowledge of the motion of rarefied gases. An account was first given of the historical development of the kinetic theory of gases, with special reference to the early work of Waterston and Joule and the rapid development of the theory in its modern form by Clausius and Maxwell Further progress has been made in recent years by Jeans and Chapman, while the experiments of Knudsen on gases of low pressure have resulted in notable contributions to our knowledge It is only in the last few years that a definite experimental proof has been given of the velocity of molecules in a gas, and of the correctness of Maxwell's famous law of distribution In the lowest vacua obtainable to day, a molecule can travel more than 100 metres without a collision, even though there may still remain 40,000 millions of molecules in every cubic centimetre of the gas

AN experimental Friday evening discourse was given on Mar 1 at the Royal Institution by Sir Robert Robertson After discussing the limitations of other methods of investigating infra red radiations, a modern spectrometer, fitted with thermopile and galvanometer, was described, and by its means an absorption band of a gas (ammonia) was mapped The origin of oscillation and rotation bands was then discussed Oscillation bands are due to vibrations of the atom in a molecule These are reflected in the main bands found in the infra red both in emission and in absorption spectra, and frequently have a harmonic relationship with one another Rotation of the molecule is shown by bands in the far infra red and in the near infra red by fringes imposed on the oscillation bands From the difference in frequency of these fringes the moment of inertia of the rotating molecule can be calculated, from which values for the length of the molecule agreeing with those reached by totally different methods can be obtained Mention was also made of the importance of infra red spectra in the study of radiation given off in the processes of combustion and of explosion, in the investigation of stellar radiation and temperature, and the secular effects of differences in climate due to changes in intensity of solar radiation. Not only does this study afford valuable data for the theoretical physicist from the points of view of the quantum theory and wave mechanics, but also it is becoming increasingly useful for determining chemical structure and suggesting molecular models. The dynamical behaviour of atoms in the molecule, and of the molecule itself as revealed by the study of this region of the spectrum, is a subject worthy of much more attention than is being given to it in Great Britain.

AT the annual general meeting of the Institute of Chemistry of Great Britain and Ireland, held on Mar 1, Dr Harold G Colman presided in the absence of Prof Arthur Smithells, who is on a visit to South Africa The Report of Council showed that the roll of membership of the Institute at the end of January consisted of 1855 fellows and 3703 associates, in addition to nearly 700 registered students The Meldola Medal for 1928 was awarded to Dr J A V Butler, the Sir Edward Frankland Medal and Prize to Cyril Fryer, and the Pedler Scholar for the year is Mr George Morrison Moir The chairman read an address from Prof Smithells, in the course of which he stated that he considers the notion of making chemistry a closed profession is entirely impracticable The Institute has been definitely entrusted with the duty, and already affords the means, of maintaining a register of chemists on which the Government, industry, and the public increasingly rely, but it does not adopt an unsympathetic attitude towards those outside its ranks who can usefully pursue a chemical calling The Institute has every variety of chemist within its ranks and is truly representative of the profession It is a living and growing thing, unconstrained by the rigidity of what is called machinery, and those who have sat at its Council table know that its work is pervaded by common sense and warmed by human feeling The following officers were elected for the ensuing year *President* Prof Arthur Smithells, *Vice Presidents* Mr Arthur J Chapman, Dr G C Clayton, Mr Ernest M Hawkins, Prof G G Henderson, Dr R H Pickard, and Prof J F Thorpe, *Hon Treasurer* Mr Patrick H Kirkaldy

Two items of exceptional interest are recorded in Mr Leonard Woolley's report on recent excavations at Ur (*Times*, Feb 26) The first is a royal burial chamber of the First Dynasty in the form of a complete underground house, 40 ft by 26 ft In it there are four intercommunicating rooms with domed and corbelled roofs The tomb had been plundered, but its importance lies in the fact that it is a new feature in Sumerian funerary custom and, as Mr Woolley suggests, explains the large number of attendants slaughtered at a royal funeral, clearly it was intended that the royal mode of life should be continued in the next world in every particular The second find, which holds out promise of future discovery, is a number of clay nodules with written tablets and clay jar stoppers with archaic sealings Although not so old as the pictographic tablets of Kish, they belong to a period hitherto represented only by rude clay figures of animals and men They were found in a mass of rubbish stretching down from the walls of the earliest Sumerian settlement to the marsh or river In such conditions there is reasonable expectation of finding pictographic material as early as that from Kish The completion of the excavation of the great temple has now laid bare its vicissitudes for the whole period of the 2500 years of its existence

THE electric meter has now been brought to a wonderful pitch of perfection Considering the

hundreds of thousands of them that are continually rotating in Great Britain, it is wonderful that such a minute percentage ever have an average inaccuracy so great as two per cent So accurate are they that they are sometimes used, with the addition of voltage and current transformers, to measure the power delivered by supply companies to tramway and manufacturing companies, meter bills of which amount to hundreds of thousands of pounds per annum In this case, an error of one per cent means thousands of pounds per annum, and hence great precautions have to be taken to secure accuracy Sometimes as many as six meters of various types are put in series and the average reading is taken as the true value Possibly in this way a maximum inaccuracy not exceeding the half of one per cent can be assured In order to secure sustained accuracy in service, it is necessary that the brake magnets remain constant and that the rotor bearings do not wear away The latter problem is considered in a valuable paper read to the Institution of Electrical Engineers on Mar 1 by W Lawson He gives a large number of experimental and statistical data on worn bearings. Various jewels which rank high in the scale of hardness have been utilised for the footstep bearing Garnets, which were formerly used, are now discarded, and rubies and sapphires are generally used It is claimed that artificial rubies and sapphires are more uniform in quality and slightly harder than the natural stones In some cases the hardest known natural substance—diamond—is used and its use is increasing The bearing surface is cupped as in other stones Its manufacture in this form is a highly specialised art The Birmingham Supply Corporation now uses these bearings for its large meters For the last thirty years also they have been used in America

In his annual report to the Department of Overseas Trade (London H M Stationery Office, 5s net) J R Cahill, Commercial Councillor at H M Embassy in Paris, gives an interesting account of the electrical industry in France Much of the prosperity of the country is due to the rapid development of this industry In the manufacturing industry, combination has reached an advanced stage Three or four groups of factories control the whole market Competition, therefore, is not severe, and prices consequently decline at a slower rate The electrification of French railways, particularly the Midi Railway, is making rapid progress In April of 1927 the Midi Railway stated that electrification saved it 130,000 tons of coal every year It now operates 500 miles of its system electrically, and aims at electrifying a further 687 miles in the next five years The total capacity of French power stations is five million kilowatts, of which more than a third is due to water power It operates more than 2000 miles of power transmission lines at pressures not less than 100,000 volts The line connecting Bordeaux and Toulouse, which is 250 miles long, works at 150,000 volts It is interesting to notice that water power is not developing so rapidly as thermal power Possibly this is due to the fact that the prices for hydro-electric energy are State controlled The possibilities in connexion with the extensive lignite deposits not far from Bordeaux for large steam stations are being considered About 30,000 people are now employed for manufacturing radio apparatus. Although French exports of radio apparatus at present considerably exceed the imports, yet a considerable amount of radio accessories, particularly loud speakers, of British and American manufacture, are sold In telephony, the automatic system is being adopted and many long distance multi-core cables have been laid As in Great Britain, the rapid progress of telephony has affected adversely telegraph traffic

A conversazione and exhibition will be held in connexion with the coming-of age celebrations of the Institute of Metals at the Science Museum, South Kensington, S W 7, on Thursday, Mar 14

Dr E J Allen, F R S, secretary of the Marine Biological Association of the United Kingdom and director of the Plymouth Laboratory, will deliver the Hooker Lecture before the Linnean Society on Mar 14, taking as his subject "The Origin of Adaptations"

At the annual general meeting of the Quekett Microscopical Club, held on Feb 12, the following officers were elected for the session 1929 1930 *President* Mr John Ramsbottom, *Vice Presidents* Mr D J Scourfield, Sir David Prain, Dr C Tierney, and Dr W T Calman, *Treasurer* Mr C H Bestow, *Secretary* Mr W S Warton

In commemoration of the bicentenary of Josiah Wedgwood in 1930, the Ceramic Society proposes to publish a volume of essays, for which two prizes are offered The competition is not limited to members of the Society All papers must reach the secretary of the Ceramic Society, North Staffordshire Technical College, Stoke on Trent, by Mar 31, 1930

A special display of the film "With Cobham to the Cape" will be shown in the Empire Marketing Board Cinema at the Imperial Institute on Mar 17 at 2 45 P M and 4 15 P M, and on Mar 18–20 daily at approximately 10 15 and 11 35 A M and 2 15 and 3 35 P M Admission is free, but schools in organised parties are requested to make application for seats to the Secretary, Imperial Institute, South Kensington, S W 7, as early as possible

The Royal Society of Arts is offering two prizes under the Thomas Gray Memorial Trust for the improvement and encouragement of navigation, one, of £150, is for an invention in the years 1928 and 1929 of an improvement in the science or practice of navigation, and the other, £50, is for an essay on the navigation of a low powered steamer in a revolving storm Full particulars can be obtained from the secretary of the Royal Society of Arts, John Street, Adelphi, London, W C 2 The competition closes on Dec 31, 1929

The Council of the Iron and Steel Institute has this year awarded the Bessemer Gold Medal of the Institute to the Honourable Sir Charles A. Parsons, in recognition of his distinguished services in advancing the science of engineering as applied to the manufacture of iron and steel The Williams Prize, of the value of 100 guineas, which was founded for the

encouragement of papers of a practical character by Mr Illtyd Williams on his retirement in 1926, has been awarded in equal portions for the two papers, "Blast Furnace Practice in Natal," by Messrs J E Holgate and R R F Walton, and "The New Plant of the Appleby Iron Co, Ltd," by Messrs A. Crooke and T. Thomson

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —A junior engineer under the Safety in Mines Research Board in connexion with research on colliery wire ropes—The Under Secretary for Mines, Establishment Branch, Mines Department, Dean Stanley Street, S W 1 (Mar 15) An assistant for work in connexion with research on water pollution—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S W 1 (Mar 20) A temporary junior forestry inspector under the Government of Northern Ireland—The Secretary, Civil Service Commission, Northern Ireland, 15 Donegall Square West, Belfast (Mar 23) An assistant agricultural chemist at Institute of Agriculture, Kirton—The Principal, Institute of Agriculture, Kirton, near Boston, Lincs (Mar 27) A principal of the new farm institute of the Kent Education Committee at Borden—The Agricultural Organiser, Springfield, Maidstone (Mar 30) A senior lecturer in psychology at the Rhodes University College, Grahamstown—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W C 2 (April 1) Male cartographers in the Hydrographic Department of the Admiralty —The Secretary, Civil Service Commission, Burlington Gardens, W 1 (May 23) A research chemist at the Cardiff City Mental Hospital—The Medical Superintendent, Cardiff City Mental Hospital, Whitchurch, near Cardiff A director of research under the J A C Committee, with graduate qualifications in agriculture, botany, and chemistry, and some experience in conducting field experiments—N Hackett, Kingswood, Bingley, Yorkshire A junior assistant under the directorate of explosives research, Woolwich—The Chief Superintendent, Research Department, Woolwich, S E 18

Our Astronomical Column

JUPITER AND VENUS —On Mar 14 a conjunction of Jupiter with the new moon will be very interesting for two reasons, namely, the near approach of the two bodies, and the convenient hour at which it happens The event will take place on Mar 14, at about 10 P M, at which time Jupiter will be apparently distant from the north limb of the moon about four tenths of a degree only The picture afforded by these objects so near together will be enhanced by the presence of the brilliant planet Venus lying about 10 degrees north west of the others Jupiter is now becoming fainter with increasing distance from the earth, but Venus will attain its maximum brilliancy on Mar 15, and shine with striking lustre amid the twilight of the north west This planet is now travelling sunwards and will disappear from the evening sky after the middle of April, but will return to view in the morning twilight of May

MARCH METEORS —There are no special displays of meteors recurrent in March, but fireballs are fairly prevalent Though meteors are not abundant they will deserve special attention, for March and the other spring months have been much neglected in past years A few careful observations in March are, therefore, worth a large number obtained in the summer or autumn months when investigations in this field have been already conducted to a considerable extent in past years

During about the third week in March, meteoric radiants at $161° + 59°$ and $312° + 79°$ have been occasionally exhibited, and there are really a great number of feeble systems slightly manifested, but possibly many of these are relics of ancient displays now very attenuated by frequent encounters with the terrestrial atmosphere in past ages.

AURORA BOREALIS —On Wednesday evening, Feb 27, an unusual and striking display of aurora was observed from various parts of Great Britain It has been described as the Zodiacal light, but the exhibition appears to have been of too brilliant a character to be considered as formed by the latter phenomenon A correspondent at Burnham-on Sea noticed the strange light just before 10 P M. Its aspect was that of an intensely coloured band stretching across the northern horizon It remained some time and passed slowly in a direction far to the westward The beam was strikingly luminous and finally disappeared soon afterwards

Accounts have come from many stations descriptive of the event and of the change in position and location which the chief feature assumed Several people thought it a remarkable meteoric fireball with very slow motion and long duration

From the south coast of Devonshire, and from Wiltshire and other stations, observers refer to the vivid nature of the spectacle It was first detected at about 9 30 P M and had nearly disappeared from view 20 minutes afterwards Mr B G Hoare, writing from Inverness, states that the display was visible from 8 30 P M until midnight At some stations streamers of pale light ascended from the horizon to considerable heights and were traceable at the zenith Changes constantly affected their intensities and positions The cloud or luminous band was the most conspicuous feature and its variations were very notable It drifted westwards, and in its transit passed over numbers of the stars, which, however, remained distinctly visible in many cases

THE CATANIA ASTROGRAPHIC CATALOGUE —The Catania Observatory undertook the zone between North Decl 46° and 55° in the Astrographic Catalogue It has had many difficulties to surmount through deaths of directors and shortage of funds, but is now issuing instalments of the Catalogue at short intervals under the direction of Prof G A Favaro The two latest instalments (vol 7, part 2, decl 52° to 54°, R A 3^h to 6^h, and vol 8, part 2, decl 53° to 55°, R A 3^h to 6^h) have lately been issued, it will be seen that decl 53° to 54° is common to both volumes The catalogue gives both the rectangular co ordinates and the R.A and Decl for 1900 0 for every star Most of the observatories limit themselves to rectangular co-ordinates, but Catania having once embarked on the more ambitious programme is unwilling to relinquish it It has of course many conveniences; the separate determinations for each star are immediately comparable without any reduction, The faintest magnitude included is 12 0

Research Items

The Teeth of Aboriginal Californians.—Dr. R. W. Leigh has made a study of pathological conditions in the teeth of three hundred crania of Californian Indians in the University of California Museum of Anthropology, which is published as No. 10 of Mem. 23 of the University's *Publications in American Archæology and Ethnology*. The specimens were derived from pre- or early post-conquest times when food habits had not been materially affected by Caucasian contact. Although food varied according to area, acorns and small seed food constituted a larger part of the diet than any other food. The grinding process for acorns, seeds, etc., was universal, and apparently this had deleteriously affected the teeth. The habitual eating of tobacco, especially when mixed with lime and mussel shells, and its use as an emetic, also affected the teeth. Other causes affecting the teeth were leaching of food with sand and cooking with hot stones. Much abrasive material was thus introduced into the mouth, and attrition with its sequelæ, is the conspicuous dental lesion in the majority. Seventy per cent of persons more than forty years of age had the pulp of one or more teeth exposed. Dental caries occurred in 25 per cent, though specimens from the shell mounds showed the low rate of 12 per cent. As a result of pulp exposure and necrosis, 52 per cent showed dissolution of continuity of bone surrounding the apices of the teeth—a result of attrition. Few teeth were lost before middle life—only ten dying at less than forty years of age had lost any teeth and most cases were well over fifty years. More superior than inferior teeth were lost.

Wooden Dolls from West Africa.—In *Man* for February, in the course of notes on the Wamakonde of Portuguese West Africa, Mr. H. D. Collings describes some remarkable little dolls of wood. The Makonde are very clever wood carvers, and these dolls are among the best things they made. They range in height from one to two feet. Their use is unknown, but coast natives state they were used in dances. They are carved in a soft white wood with a large central hole which is filled with pith. The wood is worked when green. Of two figures which are illustrated, one about 16 inches in height represents a woman. The upper lip is distended by the lip ornament, an ebony ring, and the face is covered by the usual tribal marks. The front teeth are pointed as are the teeth of the Makonde—a tribal mark. Real human hair had been driven into the head by a screwdriver like implement. A small piece of wood has been left to join the left hand to the body, a peculiarity noted in nearly every specimen. The male figure has no tribal marks and the hand is not connected with the body. This figure is stained red with some vegetable substance, the eyes being left white. The models stand upright alone when placed on their feet. They are not common, and few natives know how to carve them. The smoking pipes of this people are also of some interest. They are of the water container type, the container being a young coconut shell which is fitted with two bamboos, one of which has a movable pottery bowl. In a more elaborate form which is described, a curved central strengthening piece of wood is carved with decorative designs very similar to the tribal marks.

Nesting Habits of Oropendolas.—The oropendolas build long pendant nests in colonies, and although they are familiar enough in tropical America, no connected study of their habits has been made. Frank M. Chapman has repaired this omission by an intensive study of the oropendolas (*Zarhynchus wagleri*) of Barro Colorado Island (*Bull. Amer. Mus. Nat. Hist.*, vol. 58, 1928). In the nesting colonies, which set to work very regularly about the first week in January, females outnumber males by about six to one, and yet it would appear that each male has only one mate—at a time—and that in view of the abundance of choice there is no marked display of sexual jealousy. The males take no part in the selection of the site, in the gathering of building material, the construction of the nest, the incubation of the eggs, or the feeding of the young. But they guard the females from the attacks of hawks during nest building and generally act as watchmen. The long swinging nest hangs from the upper branches of a tree, and the building of the bag, woven of tendrils, fine strips of bark, and plant fibres, with its contained nest proper occupies one month. The male never enters the nest but the female sleeps there, and lays two eggs which hatch after an incubation period of 17 days. A month later the young leave the nest. There is no attempt at concealment either in the position of the nest or in the bright colours of the birds themselves. Their safety depends on a constant vigilance and on a spontaneous dive headlong into the dense vegetation which is never far distant, when the alarm note is sounded.

New Zealand Fishes.—In a paper entitled "Studies in New Zealand Fishes" (*Proceedings of the New Zealand Institute*, vol. 59, Part 2, 1928), Mr. L. T. Griffin, assistant curator of the Auckland Museum describes several little known fishes and two new species. These include a large eel, *Gymnothorax nubilis*, the only specimen so far recorded from New Zealand previously known from Norfolk Island and the Indian Ocean and Archipelago. This individual measures 640 mm. in length. *Seriolella amplus* n. sp. is interesting as it apparently does not vary as do the other species of the genus. It is a fine fish and very plentiful, which makes it all the more curious that it has not been described before. The mackerel described, *Scomber australasicus*, is said to be very common in deep water beyond the Hauraki Gulf, moving about the coast in large shoals, and is also common in Australian seas. The specimen of the striped angler, *Antennarius striatus*—a most grotesque creature with two pyramidal humps on its head and a lure resembling a three fronded piece of alga—was found hiding in a bunch of seaweed. Most of the species of this genus live in seaweed floating in tropical seas, and by filling the spacious stomach with air are able to keep near the surface of the water. In this way they can live in the open sea as well as near the coast, but they are very poor swimmers and drift with the currents into various places. This paper is exceptionally well illustrated by good original drawings.

The Anatomy and Habits of the Lophogastrid Crustacea.—The Lophogastrida, including the genera *Lophogaster* and *Gnathophausia*, have long been regarded as among the most primitive Mysidacea, and Miss Manton (*Trans. Roy. Soc. Edin.*, vol. 56, pt. 1, No. 5, 1928) has examined specimens of these genera in the light of the recent work on the feeding mechanisms of the Malacostraca which we owe to Miss Manton herself and to Prof. H. G. Cannon. Miss Manton finds that *Gnathophausia* has mouth parts of the typical filtratory form, and must, therefore, be at least a partial filter feeder. The mechanism is, however, more primitive than in any other living Malacostraca by reason of the absence of an auxiliary food current

created by the thoracic exopodites Locomotion is effected by the abdominal pleopods entirely, and the thoracic exopodites mainly cause currents of water bathing the gills *Lophogaster*, on the other hand, is a bottom living form, incapable of filter feeding The mouth parts are modified for feeding on large food masses, and the modifications resemble those found in the higher Peracarida which have given up filter feeding The mandibles of the Lophogastrida compared with those of other Malacostraca appear to be primitive in form, and to show the origin of the *lacinia mobilis* The author has also investigated the segmentation of the abdomen and the muscular system of the terminal 'segment' in *Lophogaster* and *Gnathophausia*, and finds that the groove across the last 'segment' of the abdomen in the Lophogastrida represents the junction between the incompletely fused sixth and seventh segments In a previous paper the author has shown that the last abdominal segment in the adult of *Hemimysis* is formed by the complete fusion of the separate sixth and seventh segments present in the embryo In the Lophogastrida the fusion between these segments is therefore incomplete This interesting observation brings the segmentation of the Eumalacostraca into line with that of the Leptostraca (*Nebalia*) where a completely separated but limbless seventh segment in the abdomen is a feature of the adult condition Miss Manton concludes that the Lophogastrida are the most primitive living members of the Malacostraca

PHILIPPINE WOODS —In the May number of the *Philippine Journal of Science* Mr Jose C Espinosa of the Bureau of Science, Manila discusses "Strength Properties in relation to specific gravity of Philippine Woods" The paper, which is illustrated by five text figures, is of a technical nature and designed for research workers in this branch of investigation The strength properties of wood have a certain definite relation with its density or specific gravity Newman and Wilson have carried out an analysis of 200,000 tests at Madison for American timbers and L G den Berger in the Dutch East Indies has worked on teak Mr Espinosa has carried out about 45,000 tests for some of the more valuable Philippine timbers and presents their relationships both in graphical and in equation form

GLACIAL DRIFTS AND ERRATICS —The Yorkshire Geological Society and Sir Sidney Harmer have laid British geologists under a debt of gratitude for making possible the posthumous publication of a paper on "The Distribution of Erratics and Drifts" in England and Wales, accompanied by a beautifully layer coloured contoured map on which the distribution is effectively displayed, both paper and maps being the work of the late F W Harmer (*Proc Yorks Geol Soc*, November 1928, pp 79 150, and sold separately by John Bartholomew & Son, Ltd, Edinburgh 10*s* with folded map, or 11*s* with unfolded map on a roll) Mr Harmer had a personal familiarity with the drift deposits extending over some sixty years, which was unrivalled in extent and achievement, and the invaluable result of this long service to geology is the first detailed mapping of erratics in England and Wales The map itself is on the 1/*M* scale and measures about 20 in × 25 in, it includes southern Scotland south of Peebles and Lanark The contour interval is 100 ft up to 600 ft, thereafter the contoured levels are 1000 ft, 1500 ft, and 2000 ft By the use of an ingenious system of twelve distinctive symbols printed in heavier colours than those used for the contour intervals, the following varieties of drifts and erratics are recorded North Sea, Chalky Boulder Clay (chalk matrix), Chalky Boulder clay, (Jurassic matrix), Pennine (Carboniferous), Pennine (Silurian), Welsh, Lake District, Cheviot and Galloway, Bunter Pebble, Charnwood, Eocene of Herts, and Neocomian (erratics of large size) The map is a masterpiece of clarity and accurate registration The very high cost of reproduction has been made possible by the generosity of Sir Sidney Harmer and his co trustees under his father's will It will interest many readers to know that the original map has been presented to the Geological Survey and Museum in Jermyn Street

IRRIGATION IN INDIA —The Triennial Review of Irrigation in India of which the issue for 1924–27 has now been published by the Government of India contains much useful statistical information It recounts the progress of irrigation in the various provinces of British India and gives financial statistics for all the irrigation works The irrigated area is now a little more than twenty eight million acres In productive irrigation works every province shows an improvement compared with the previous triennium The irrigated area is as much as 88 per cent of the total cropped area in Sind, and averages for the whole of British India 12 8 per cent being naturally very low in Bengal, Bombay Orissa and the Central Provinces Not the least valuable part of the pamphlet is the account given of the various irrigation projects in each province

THE ORIGIN OF MAGNETISM The issue of the *Physikalische Zeitschrift* for Dec 15 contains an account by Dr O V Auwers of recent work on the question why certain substances are magnetic and others not According to Heisenberg each atom of a magnetic element must have at least 8 neighbouring atoms of the space lattice at equal distances from it According to the author an examination of magnetic elements furnishes no direct contradiction to this law But when magnetic α iron passes into non magnetic β iron or magnetic α nickel into non magnetic β nickel between 700 and 800 C there is no distinct change in the space lattice of either Alloys of two of the magnetic elements iron nickel, and cobalt are sometimes non magnetic although the space lattice suggests by Heisenberg's rule that they should be magnetic On the other hand iron pyrites and magnetite are both magnetic, although they do not conform to the rule At present therefore we appear to have no satisfactory explanation of the origin of magnetism

ABSORPTION OF PENETRATING RADIATION —The only method yet devised for analysing the spectrum of the cosmic rays is to find by experiment how their intensity falls off in their passage through matter and then to calculate the wave lengths which correspond to the observed coefficients of absorption by making use of some specific theory of the interaction between radiation and electrons The two principal absorption formulæ which have been employed are those associated with the names of Prof A H Compton and of Dr Dirac, but recently a relation with a better theoretical basis has been proposed by Klein and Nishina (see NATURE vol 122, p 398) In interpreting the absorption curves it is also necessary to consider precisely what is registered by a γ ray electroscope and a new analysis of the problem by L H Gray (*Proceedings of the Royal Society* vol 122, p 647, Feb 4) in which all of these factors have been taken into account, has shown that the wave lengths which had previously been accepted as correct are probably in need of considerable revision The formula of Klein and Nishina is not only the most satisfactory of the three theoretically, but it also agrees best with the somewhat meagre data which are available concerning the absorption of γ rays of known frequency If this is adopted, the principal rays in the spectrum of the

penetrating radiation work out to be of even shorter wave length than Prof Millikan and Dr Cameron had supposed, and have quanta of 90, 360, and 920 millions of electron volts respectively The last number corresponds to the annihilation of a mass almost exactly equal to that of a proton, whereas Prof Millikan and Dr Cameron had suggested that it arose from the catastrophic condensation of a number of hydrogen nuclei and electrons to form the nucleus of an atom of silicon, magnesium, or aluminium

RADIO ACOUSTIC POSITION FINDING —In order to construct the nautical charts used in the naviga tion of ships it is essential that accurate hydro graphic surveys be periodically made In this way sunken rocks, reefs, and wreckage are accurately charted One of the methods, developed during the War, of locating objects is to utilise the difference be tween the speed of radio waves and under water sound transmission Many difficulties had to be overcome, such as the failure of sound to carry under certain con ditions and the interference at shore stations The U S Coast and Geodetic Survey has published a useful booklet (*Special Publication* No 146, price 20 cents) giving a clear and full account of the method and details of the instruments used by the survey ships operating on the Pacific Coast of the United States Radio acoustic control has been used for the last four years and has proved of great value It can be used regularly up to a distance of 70 miles from the shore, but in special cases it has been used at 200 miles It is independent of fog, but during storms the noise of the waves breaking on the beach sometimes causes difficulty The under water sound is obtained by exploding a bomb, and the noise is picked up by a suitably placed receiver connected through an ampli fier to a relay, both the sound and the radio signals being amplified A chronograph with two pens marks the instants when the sound and the radio signals are received The time taken by the sound travelling through the water to two stations on the coast is ob served Hence since the velocity of sound in sea water of known salinity and at known temperature is given by tables their distances can be found and the ship's position obtained Sometimes the noise made by fishing boats anchored near the sunk hydro phone makes it impossible to distinguish which are the bomb noises The only remedy is to remove the boats Another source of trouble was traced to fish bumping against the hydrophone box and to crabs climbing over it

CHEMICAL EFFECTS OF CATHODE RAYS —The *Journal of the American Chemical Society* for December contains three papers on the chemical effects of cathode rays The first two papers, by A L Marshall, deal with the formation of ozone and the union of hydrogen and oxygen effected by cathode rays from a tube operated at 200 kv and 0 001 amp Cathode rays bring about the ozonisation of oxygen and also the decomposition of ozone, the reaction taking place entirely in the gas phase A steady state is reached corresponding with a concentration of 1 molecule of ozone to 1700 of oxygen The silent discharge pro duces a concentration of 1 in 12, but has a much smaller decomposing effect than the cathode rays The reaction is uninfluenced by the nature of the walls of the containing vessel In the reaction between hydrogen and oxygen brought about by the rays, it was found that the primary products are hydrogen peroxide, water vapour, and ozone The rate of formation of the peroxide is independent of concentration, whereas the rates of formation of water vapour and ozone, which parallel one another, are both changed by variations in concentration It is suggested that both water vapour and ozone are produced by the same primary mechanism The third paper, by W F Busse and F Daniels, is con cerned with the chemical effects of the rays on oxygen, air, nitric oxide, and carbon dioxide These effects were expressed as the ratio of molecules produced per electron crossing the cathode ray tube, and were nitric oxide decomposition 230, ozone from oxygen 100, ozone from air 44, nitric oxide from air 14, carbon dioxide decomposition 3 The results described in all three investigations show that there is a close similarity in the chemical behaviour of cathode rays and α particles

ATOMIC WEIGHT REPORTS —Since the International Committee on Atomic Weights has not provided a table since 1921, the Report and Table of Atomic Weights prepared by the Sub Committee of the Chemical Society (*Journal of the Chemical Society*, pp 216 219, 1929) and those prepared by the German Atomic Weight Commission (*Berichte*, vol 62 pp 1 23) afford an interesting basis for comparison It is satis factory to note that of the eighty four elements tabu lated, only fourteen differ in more than one unit of the last significant figure in the weights assigned to them by the two tables Of these, the more important are carbon, sodium phosphorus, and arsenic, for which the English Sub Committee adopt the values 12 003_6, 23 000, 30 98_2, and 74 93_4 respectively (last figures are uncertain), on the basis of the results obtained by Aston with the mass spectrograph, the German values are 12 000, 22 997, 31 02, and 74 96 respectively For magnesium (24 30, 24 32—the English value is given first in each instance), calcium (40 09, 40 07), chromium (52 04, 52 01), manganese (54 95 54 93), niobium (93 3 93 5) gadolinium (157 0 157 3), and tantalum (181 3, 181 5), the English value is that recalculated by F W Clarke in 1919 since when there have been no new determinations There re main silicon (28 08, 28 06), copper (63 55, 63 57), and thorium (232 15, 232 12), with which there is no im mediately obvious reason for the slight differences Interesting features are, in the German Report, the provisional atomic weight 188 71 for the newly dis covered element rhenium (Re), which has been investi gated by Walter and Ida Noddack, and in the English report the arrangement, for the first time in an annual atomic weight table, of the elements in the order of their atomic numbers

FLAMES IN NITROUS OXIDE —The normal infra red spectrum derived from a flame is usually that of the products of reaction and not of the reacting gases This may arise from the fact that in most cases the supporter of combustion is oxygen or air, which are without characteristic infra red spectra In the *Journal of the Chemical Society* for January, Bailey and Lih describe experiments on the emission spectra of gases burning in nitrous oxide In the case of carbon monoxide and coal gas the anticipated spectra of water vapour and carbon dioxide were found, but a different result was obtained with hydrogen The flame of a mixture of this gas with nitrous oxide is very complex and consists of at least five zones, but the normal type of spectrum due to water vapour is shown When, however, a hydrogen jet is burned in nitrous oxide, a new spectrum appears, some bands of which appear to correspond with known absorption bands of nitrous oxide This new spectrum is not exhibited by carbon monoxide or coal gas in either mode of burning, and is probably due to some form of stimulation by burning hydrogen molecules It does not appear in the coal gas flame and is then probably inhibited by the carbon monoxide present Hence the stimulation is probably not merely thermal

British and Foreign Ammeters and Voltmeters

AT all electric generating and distributing stations large numbers of ammeters and voltmeters are fixed on the switchboards so that the attendants can see at a glance how the various electrical machines are working The manufacture of these instruments is quite an important industry, and we are glad that the manufacturers in Great Britain are thoroughly aware of the necessity of continually improving the design and accuracy of their instruments in order to meet foreign competition One sometimes hears from an engineer that a particular foreign instrument maker makes the best instruments, but there is no general agreement as to which foreign firm makes the 'best,' or in what respect these instruments are better than those made in Great Britain An investigation was therefore initiated by some of the members of the British Scientific Instrument Research Association to find out whether there was any foundation for these reports It was thought also that a careful comparison of the types of instruments made in America, Europe, and Great Britain would be of value as it might suggest to makers improvements in the design of their instruments

To bring the inquiry within manageable limits, it was decided to restrict the investigation at first to permanent magnet moving coil instruments and we have received a synopsis of the detailed report circulated to members of the Research Association For obvious reasons the names of the manufacturers are not mentioned, but the instruments are classified under the headings of British and foreign and a critical and impartial account is given of their design and performance

The manufacture of these instruments has lasted over so many years that the general lines of their design have become almost universal To obtain certain characteristics, however, different methods are adopted, and it is necessary to make compromises at almost every point in their manufacture, the instrument being judged on the general 'balance' obtained Users of instruments have generally definite preferences due to a liking for some particular detail in the design Not infrequently these preferences have no specific foundation and are merely personal

The instruments tested for the Association were 'dial type' switchboard ammeters and voltmeters varying from six to eight inches in diameter They were examined for rapidity of indication, accuracy, effect of temperature, internal construction, nature of the springs and of the magnetic system, appearance, and kind of pointers and dials used

In some of the instruments examined the damping was much too small When switched into the circuit the pointer moved over the scale in its first swing and struck violently against the stop at the upper end of the scale In some cases, also, there was a tendency for the pointer to stick at the upper end of the scale In other cases the pointer oscillated for some time before coming to rest The conclusion is arrived at that in the best instruments the damping should be almost but not quite critical, that is, that the pointer should swing slightly beyond its final position but return rapidly to it

Of the instruments examined, 60 per cent were accurate to within 1 per cent, 30 per cent had errors between 1 and 2 per cent, 8 per cent had errors between 2 and 3 per cent, and one instrument had an error of more than 9 per cent The general level of the accuracy of the British instruments was at least as high as that of the foreign instruments

The instruments were affected in very varying degrees by temperature Some of them were specially compensated for temperature In one of the British instruments the compensation was practically perfect from 10° to 50° C, the sensitivity of the instrument being constant to within one or two parts in one thousand over this range It appears that compensation for temperature can be provided to a satisfactory extent by a proper choice of the materials used in the moving coil circuit, control springs, shunt, etc The arrangements for zero adjustment were very varied In one case it was necessary to open the front of the instrument case to make the adjustment but in another the arrangement was very neat and efficient

The practice of fitting resilient supports to the jewels is to be commended, as it affords considerable protection against the risk of damage due to vibration or mechanical shock The instruments of two British manufacturers who follow this practice have a distinct superiority in this respect over all the others Some of the manufacturers use copper wire for their coils and others aluminium The use of aluminium has certain advantages, but it is difficult to solder Phosphor bronze springs were used by all the manufacturers for their instruments Only in two of them was the position of the zero reading of the pointer found unchanged after they had been in circuit for seventy two hours The pointers came back to their original zero positions after intervals varying from a few minutes to twenty four hours It was found that instruments with large air gaps in their magnetic circuits were not necessarily inferior to those having smaller air gaps It is necessary however, to maintain a proper relation between the magnetomotive force of the magnet and the reluctance of the magnetic circuit

So far as the external appearance of the instruments is concerned, it is best that only the scale and the pointer should attract the eye Full white dials and bright lacquered brass cases are not desirable It was found that certain scales were easier to read than others, and this was attributed to a better balance between the thickness of the gradations and their height The instruments were not tested to determine the extent to which their indications were affected by external magnetic fields We think that this was a pity, as many switchboard instruments are seriously affected in this way It is stated however, that inspection of the instruments showed that some would be affected much more than others

In conclusion, the report says that the best of the instruments examined, both British and foreign, were well suited for the purpose for which they were designed Two pairs of instruments of British manufacture were open to criticism in respect of certain details of construction, and two pairs of foreign instruments were distinctly inferior both in design and construction None of the instruments showed an outstanding superiority over all the others in every particular If the instruments are placed in order of merit as assessed on some particular criterion of excellence, the instrument placed first would in many cases be a British one Certain of the British instruments examined would occupy high positions whatever criterion were chosen The consistently high positions occupied by certain British instruments in the tests described above leads to the conclusion that the best known British instruments of the kind examined are quite equal to the best known corresponding instruments of foreign origin

The Timber Resources of the British Empire

ACTING under a resolution of the Imperial Conference which sat in London in 1926, an Imperial Economic Committee was appointed consisting of nominees of Great Britain, the Dominions, India, and the Colonies and Protectorates. The Imperial Conference directed the Economic Committee to prepare for the consideration of Government a list of raw materials suitable for inquiry on the lines of the Committee's reports dealing with foodstuffs. In 1927 the Governments of the Empire agreed that the Committee should prepare such a report on timber. This report (*Rep. of Imp. Econom. Committee*.—Tenth Report.—Timber. London: H.M. Stationery Office, 1928) has been recently published. It is based on the examination of a number of witnesses representing producing, marketing, and manufacturing interests, and on the expressed opinions of experienced officials and scientific workers.

The authors of the report give their reasons for confining themselves to timber and omitting other forest produce in the following: "We have excluded from our enquiry the wide range of articles frequently described as 'minor forest produce,' including grasses, canes, gums, and tanning materials. We have only referred to the imports into the United Kingdom of manufactured wood, of wood pulp and of cellulose for the purpose of indicating the total demand made by the United Kingdom on the sources of wood supplies. We took some evidence on the import trade in manufactured wood, but found that this raised very large issues, an examination of which would have prevented the production of this report in time for the forthcoming Forestry Conference. We therefore deemed it advisable to confine this Report to the raw material—timber. The timber trade is a very important one, and the Empire resources are extensive and varied."

One of the chief points, perhaps of equal interest and importance, which emerges from the evidence taken by the Committee, is the difference of opinion on the subject of world timber supplies of softwoods which exists between the members of the timber trade and forest authorities 'all the world over,' as the Committee expresses it—although it is doubtful whether there is such a universal consensus of opinion as this statement would appear to indicate. However, the forest authorities are said to regard the world supplies of soft woods with anxiety, whereas the authors state: "We must, however, record the fact that in the course of our enquiry we have not found this feeling of apprehension shared generally by the members of the timber trade in the United Kingdom. Adequate supplies have always been readily available in the past, and it is possible that the trade has been lulled into a feeling of security for the future which the world position may not warrant. The commercial point of view is that a scarcity of supplies will adjust itself by an increase of prices which will bring within an economic radius fresh forest areas hitherto untouched." Many forest officers would say that the local timber traders have as good knowledge of the local forests' resources as they have themselves. It is at least open to doubt whether the statement in the report that "the outlook is more fully realised by those concerned with organised forest management and conservation" can be accepted without considerable reservations.

Although the examination of forest resources does not fall within the purview of the Committee in the present report, the necessity for systematic investigation of the rate at which the softwood resources of the world are being depleted is strongly urged. It is well known that Canada contains practically the only supply in the British Empire of such materials, and probably the estimates of existing amounts are fairly trustworthy. The remaining resources are chiefly in European countries, and "systematic investigation" into their rate of depletion is not a practical possibility. We have to rely upon published figures—trade and otherwise, and on reports and information with which the officials of these countries courteously supply us.

The second point in the report is of Empire importance, and in it is embodied the entire value of statistics on Empire resources. The authors write: "If the interest of the timber trade and of the general public is to be enlisted for the conservation and development of the Empire forest resources and the lesser known varieties of Empire grown timber are to secure wider utilisation, statements regarding the world and Empire position must be supported by statistics based on precise knowledge and not on information of a general character." This goes to the root of the whole matter.

For the first British Empire Forestry Conference, held in London in 1920, a tabular form was drawn up, it is believed in London, and sent to forest authorities in countries of the British Empire asking for estimates of the total forest resources of these regions, distinguishing areas containing merchantable timber (exploitable forests) from non-merchantable. Some of the forest authorities produced figures for which they accepted no responsibility; others refrained. In Canada, at the Conference held in 1923, the same request was put forward, and in the report here under review the authors state: "Thus it is anticipated that in the autumn of the current year [*i.e.* after the meeting of the Empire Forest Conference in Australia] information on the timber resources of the Empire will be forthcoming more complete than any at present available." This latter is a possibility. But the statistics 'will not be based on precise knowledge,' which is what the Economic Committee rightly demands. How could they be? When a conservator of forests, in charge of one of the Empire provinces containing extensive tropical and sub-tropical forests, receives the form alluded to above, he sends copies to his several divisional officers. These men may have charge of an area of anything from 500 to 2000 sq. miles of forest (or more), in many cases much of it unknown and unexplored. They have a staff small in size and partially trained. How are they to produce any figures of stocking, either in proportion of species or volume per unit of area? Even the map areas of the forests are perhaps only rough ones. To anyone who has held charge of similar areas the possibility of obtaining any figures but those based on guess work will be perfectly obvious. Yet a large proportion of the tropical and sub-tropical forests of the British Empire are in this position. Very much stronger trained staffs and opening up of the forests will be necessary before the value of the returns on the timber resources of the Empire are based on "precise knowledge" as against "information of a general character." Outside the Empire there are extensive areas of tropical and subtropical forest (in South America, for example) which are as yet under no true forestry management at all.

We are in full agreement with the writers of the report "that it may be found necessary to make arrangements for the systematic collection and revision of World and Empire consumption in relation to supplies." But the primary basis for those preparing reports in London and suggesting work to be carried out, at any rate where forests and forestry are in question, is to remember that the unit of area is the square mile, the type of forest tropical or sub-tropical, the vegetation often dense and difficult to get through,

whilst the topography of the countryside often offers considerable obstacles to easy or rapid travelling The young British forest officer minds none of those things But knowledge, a trained staff, plenty of time (which entails much larger staffs), and an adequate equipment are required if the figures obtained for the total forest resources of the Empire (even for merchantable timber) are to be of a practical value We find no reference to this part of the problem in the report under review

The suggestion for co operation amongst the owners of woods in Great Britain for improving their woodlands and in marketing the produce are to the point also on the important subject of the introduction of new Empire hardwoods on to the home markets In this latter matter the forest officer is practically powerless It is a question for the timber merchant, and as the writers of the report rightly say, the introduction of new timbers "involves risk and expense which exporters with or without Government aid, must be prepared to undertake", and they add "We advocate a policy of restraint in regard to the number of varieties of new Empire timbers which are concurrently introduced into the British market"

This report is a valuable piece of work covers a wide range of outlook in the timber problems of the British Empire and its perusal may be strongly recommended to all who are in any way interested in timber supplies

The Four Component System in Peace and War

DR F A FREETH, of Imperial Chemical Industries Ltd honorary lecturer in the theory and practice of heterogeneous equilibria at University College, London, gave his inaugural address on Friday, Mar 1 on "The Four Component System in Peace and War"

The particular type of four component system with which Dr Freeth dealt is known as the reciprocal salt pair, or as a double decomposition One of the latest and best known examples of this is the conversion saltpetre process, whereby potassium chloride and sodium nitrate are converted into potassium nitrate and sodium chloride The subject was developed along the lines of Meyerhoffer one of the pioneers of this field who published his paper about thirty years ago but the method of representation used to explain the original arguments was that developed by Prof Janecke of the Technical High School Hanover

The method of representation takes the form of a cube the base of which represents all the possible mixtures of the salts whilst water is plotted vertically Considering the base of such a cube only, that is to say, the relative proportions of the salts, such base can be considered as being divided into four areas, each of which represents saturation with respect to one of the four salts under consideration If by any means a solution can be obtained within an area representing saturation with respect to a particular salt, then generally speaking it is possible to obtain that salt in a pure condition

The famous reciprocal salt pairs of commerce were then considered, particular attention being paid to the ammonia soda process which was developed in Great Britain by the late Dr Ludwig Mond Several other well known working processes were also discussed, notably the caustification of sodium carbonate by lime giving caustic soda All these old commercial processes were developed empirically, and it is generally found that current practice corresponds very closely with the optimum conditions predicted by a stringent theoretical treatment

Reactions of this character played a very important part in the War Fixed nitrogen is essential for modern explosives, both for propellants and for the high explosives used for bursting charges in shells Until the War, the main source of fixed nitrogen was Chile nitre, treatment of this nitre with sulphuric acid yields nitric acid, which can be converted into high explosives like tri nitro toluene, propellants such as cordite, and by neutralisation with ammonia can be made to yield ammonium nitrate Germany obviously could not depend indefinitely on the Chile supplies, so the Haber and the Ostwald processes were developed The Haber process makes ammonia, using coke, air, and water as raw materials, the Ostwald process, by burning ammonia with a limited quantity of oxygen, converts it into nitric acid After these processes were once developed on a sufficiently large scale Germany was automatically independent of any outside supplies of fixed nitrogen Both processes, more especially the Haber process required very considerable advances in technique

On the outbreak of war in 1914 it soon became manifest that immense supplies of fixed nitrogen would be required by Great Britain Even assuming that the productive capacity making nitric acid on the old lines would have been sufficient there was a shortage of toluene for the necessary quantity of T N T had that explosive been exclusively used It was speedily discovered that T N T could be diluted with no less than four times its weight of ammonium nitrate without impairing the high explosive properties of the mixture The supply of ammonium nitrate, therefore became of vital importance Lord Moulton, the director of Explosive Supply, was faced with the following dilemma Should he attempt to erect Haber and Ostwald plants of the necessary size or should he attempt to make ammonium nitrate by double decomposition using Chile nitrate as his source of fixed nitrogen? He decided on the latter course for the very good reason that he considered the enormous calls on technical men of every kind rendered it almost out of the question to develop what was, in Great Britain, an entirely novel process

Three double decomposition processes were used in the War period, and nearly all of them had been considered as technically impossible after practical trial These processes were

(1) The ammonia soda reaction on sodium nitrate giving ammonium nitrate and sodium bicarbonate (2) Conversion of the waste calcium chloride of the ordinary ammonia soda process into calcium nitrate by double decomposition with sodium nitrate and the subsequent decomposition of the calcium nitrate with ammonium carbonate yielding ammonium nitrate and calcium carbonate (3) Double decomposition of sulphate of ammonia and sodium nitrate giving ammonium nitrate and sodium sulphate This latter process, after initial failure, afterwards became successful, it was worked on a very large scale in Great Britain and upon a still larger scale in the United States All these processes were developed both theoretically and practically in the research laboratories of Messrs Brunner Mond and Co, Ltd, of which Dr Freeth was the head

Finally, Dr Freeth paid tribute to the extraordinary help which those engaged in developing this process had received from theoretical work of the Dutch school, notably of Prof Schreinemakers in Leyden, while the germ of all the theories involved goes back to a most distinguished American mathematical philosopher—Willard Gibbs—probably one of the most detached men who ever lived

Fauna of the Paraguayan Chaco Swamps

A SERIES of papers on the fauna of the tropical swamps of the Paraguayan Chaco were read at the meeting of the Linnean Society on Jan 3 Messrs G S Carter and L C Beadle, in a preliminary paper, dealt with the relation of the fauna to the physico chemical conditions of the environment These swamps cover large areas of the plains to the west of the Paraguay River on the latitude of the southern tropic, those in the neighbourhood of the station of the South American Mission Society at Makthlawaiya (58° 19′ W, 23° 25′ S) were investigated They are shallow, frequently dry, and are filled with much aerial vegetation in all parts During eight months (October 1926–June 1927), observations were made at regular intervals of several characteristics of the water in the swamps The most striking observations were (1) The high temperature which the surface layers of the water were sometimes found to reach (42° C), (2) the large quantities of phosphates always present (up to 10 mgm per litre), (3) the low tension of dissolved oxygen, not more than 2 3 c c per litre in the surface layers, while below the upper 4 6 in there was scarcely ever more than 0 2 c c per litre during the hot weather This low oxygen content is believed to be due partly to the poverty of the aquatic flora, partly to the great activity of decay at the high temperature, and partly to the absence of convection currents caused by the cooling of the surface layers at night The behaviour and distribution of the fauna show that the shortage of dissolved oxygen in the water is the greatest bionomic factor

Dr R Gurney submitted a report on the Branchiopoda of the expedition Dr Carter's collections include five species of which three appear to be undescribed Four of them are Conchostraca, and include the remarkable *Cyclestheria hislopi*, which is found also in Africa, India, Ceylon, and Australia

Mr E Meyrick discussed the Microlepidoptera which were collected The nature of the region would probably not be very favourable to Microlepidoptera The number of species in identifiable condition is 32, of these, 2 genera and 22 species are described as new Of the remainder, 3 are horticultural pests introduced with their food plants, 1 a widely spread American insect, 2 are found also in the Argentine and 4 in the Amazon valley The new species are generally of Guiana and Amazon types

Messrs Carter and Beadle described their observations on the habits and development of *Lepidosiren paradoxa* The subsoil of clay, which occurs everywhere in the parts of the Paraguayan Chaco inhabited by this fish, preserves water in the burrow used in dry weather, thus keeping its skin moist Oxygen is normally absent from the water surrounding the nest of the *Lepidosiren*, and the manner in which the respiratory needs of the eggs and young larvæ are satisfied is discussed The normal rhythm of the contraction of the pigment cells of the skin of the larvæ at dusk and their expansion at dawn is preserved for some days when the larvæ are kept in the dark continuously

Dr J Stephenson dealt with the Oligochæta Oligochæta have been collected from the northern and more remote part of Paraguay only twice previously, and then only in small numbers, hence the present collection contains a large proportion of new species Limicoline forms are in the majority A considerable part of the interest of the present collection lies in considerations of geographical distribution

Dr W A Cunnington reported on the Argulidæ of the expedition, which belong to the genera *Dolops* and *Argulus* The two species of *Dolops*—*Dolops striata* (Bouvier) and *Dolops geayi* (Bouvier)—are of interest, as certain specimens are larger than any hitherto recorded The single species of *Argulus* appears to be new to science

Mr H W Parker discussed the Amphibia and Reptilia which were collected Dr Carter's collections contain two tadpoles and a half grown example of the frog *Ceratophrys lævis* (Budgett) The tadpoles, hitherto undescribed, have mouth parts of a kind unique amongst the Salientia, and, as their food is exactly similar to that of some other species of *Ceratophrys*, this suggests that *lævis* is not closely genetically related to the other members of the genus in which it is at present included

University and Educational Intelligence

CAMBRIDGE —D J Watson, Downing College, has been appointed to the Frank Smart University Studentship in Botany J C P Miller, Trinity College, has been elected to the Sheepshanks Exhibition

THE Chadwick Trustees invite applications from British subjects between twenty five and thirty years of age who are graduates of a British university or of equivalent standing, for two travelling scholarships of £400 each, to enable the holders to travel abroad during one year to study methods adopted in other countries for the prevention of disease and the improvement of the public health One scholarship will be for sanitary science and the other for municipal engineering Applications must be sent in before Mar 25, full particulars may be obtained from the Clerk of the Chadwick Trustees at 204 Abbey House, Westminster, London, S W 1

PARENT TEACHER associations have so grown, says the United States Bureau of Education in the November issue of *School Life*, that they have become one of the outstanding forces in American education Their members, numbering more than a million and a quarter, are organised under the guidance of the National Congress of Parents and Teachers, founded in 1897, for the promotion of a better understanding between parent and teacher with consequent co operation between home and school and appreciation on the part of all citizens of their responsibility to the younger generation The Congress executive operates, with the help of the teacher members, an ambitious scheme of adult education in which it has the powerful backing of the federal Bureau of Education and last September it promulgated a manifesto urging the supreme importance of universal education for parenthood In this document, which was published in the October issue of *School Life*, it calls upon universities and colleges to develop special courses in this subject in their teacher training, extension and correspondence study departments, exhorts public librarians to organise special facilities for its study, and State and city school officers to plan for bureaux of parent education The Bureau of Education is supporting this movement by publishing a series of nine articles by eminent authorities concerning parent teacher associations in their relation to the children and to the schools of elementary, secondary, and higher grade The first of these, on the Congress programme of parent education, appears in the November issue of *School Life* Others will deal with pre school education, the teacher, the parent and the curriculum, recreation as a necessary part of home life, parents and the sex question, parents and high-school students, parents in higher education, books, and parent education in the home

Calendar of Patent Records

March 11, 1835—A patent was granted to Robert Jupe, upholsterer of London, on Mar 11, 1835, for an improved expanding table in which the width was enlarged as well as the length, the principle being applicable to round or other shaped tables The table top was divided into a number of sections which could be caused by suitable mechanism to diverge from the common centre, the spaces thus formed being filled by inserting 'leaves'

March 12, 1839—The patent granted to Job Cutler of Birmingham for an improved method of constructing chains for suspension bridges and other purposes, and dated Mar 12, 1839, is one of the rare cases in which a caveat against the grant of a patent was entered at the Great Seal, the last stage at which a patent could be opposed The Attorney General, on the evidence of John Farey, reported against the grant, but the Lord Chancellor overruled the objection and sealed the patent as of the original date

March 13, 1561—The patent granted to Philip Cockeram and John Barnes in 1561 for the manufacture of saltpetre affords the first known instance of an official specification or written description in connexion with a patent for an invention, though the delivery of the description was not a condition of the grant It appears that Queen Elizabeth agreed to pay Gerrard Honricke, a German, the sum of £300 if he would teach certain of her subjects how to make saltpetre as it was made on the continent and would also give an account of the process in writing The 'specification' was duly delivered to the Secretary's office on or about Mar 13, 1561 The Queen thereupon granted a patent to Cockeram and Barnes for ten years, and transferred to them the obligation to pay Honricke the stipulated sum

March 14, 1769—On Mar 14, 1769, within a few weeks of James Watt's steam engine patent being sealed, a patent was granted to Francis Moore, draper, of London, which made Dr Small write to Watt "Moore has taken out a patent for moving wheel carriages by steam This comes of thy delays At this moment, how I could scold thee for negligence" Watt was not, however, perturbed by the information, and replied that Moore could not make a steam carriage without using his (Watt's) patent, and that if he did use it, Watt would easily be able to stop him No specification was enrolled with Moore's patent, and the only evidence of his improved carriage shows a horse drawn vehicle having very large diameter wheels

March 15, 1784—The argand burner, the first notable improvement on the primitive oil lamp, was invented by Amié Argand, a French chemist living in London, and patented by him in England on Mar 15, 1784 Argand was anticipated in France by Ambroise Lange, who had seen the invention in London and gave it to the Paris Academy as his own Later, the two joined forces, and a French patent was granted in the two names, but this with other similar privileges was suppressed by the Revolution and the invention thrown open to the public Argand's reason gave way under the series of misfortunes and he returned to England to devote the remainder of his life to an attempt to discover the elixir of life

March 16, 1744—A patent was granted to Samuel Sutton on Mar 16, 1744, for a method of extracting the foul air from the holds and living quarters of ships through pipes heated by the ordinary cooking and other furnaces of the ship Sutton himself tells that he experienced great difficulty in getting the invention adopted by the Admiralty, but eventually it was installed in a large number of H M ships

Societies and Academies

LONDON

Royal Meteorological Society, Feb 20—**L H G Dines** The Baker automatic release for dropping the meteorograph from a registering balloon at a predetermined height—**C K M Douglas** Some aspects of surfaces of discontinuity The more important pressure changes on weather maps are due mainly to large scale horizontal movements at levels round about the base of the stratosphere, considered in conjunction with movements at lower levels The changing pressure fields cause converging and diverging movements, which influence fronts and produce inversions where the air is subsiding—**E Kidson** and **H M Treloar** The rate of ascent of pilot balloons at Melbourne Atmospheric turbulence is the most important cause of departures from the normal rate of ascent The greater the turbulence the greater is the mean height The turbulence due to surface heating of the air is more effective than wind turbulence in increasing the rate of ascent in the lowest layers The heat turbulence is effective chiefly near the surface and in light winds The rate of ascent is less in stable than in unstable air under the same conditions as to turbulence

Physical Society, Feb 22—**L F Stanley** The construction and calibration of a sensitive form of Pirani gauge for the measurement of high vacua The gauge consists of a manometer and a compensator, the one identical with the other, placed in the opposite arms of a Callendar Griffiths bridge, each consists, essentially, of a loop of 10 cm of platinum wire of 0 001 inch diameter, together with a compensating loop of 2 cm of the same wire The symmetry of the circuit makes errors due to thermoelectric effects very small The gauge follows variations of pressure with considerable rapidity, and its range of measurement is from 2×10^{-3} mm to 4×10^{-6} mm approximately—**Charles H Lees** The free periods of a composite elastic column or composite stretched wire The free periods of the longitudinal oscillations are determined when both ends of the column are nodes when one is an antinode and when both are antinodes A graphical method of dealing with the problems is developed—**Allan Ferguson** and **J A Hakes** A capillary tube method for the simultaneous determination of surface tension and of density A capillary tube of radius r is immersed vertically to a depth h_1 in a liquid of density ρ_1 The pressure $g\rho h$ required to force the meniscus down to the lower end of the capillary and to hold it there is measured If h_1 and consequently h be varied, a plot of h against $(h_1 - r/3)$ gives a straight line, from slope and intercept of which the surface tension and the density of the liquid may be inferred

CAMBRIDGE

Philosophical Society, Jan 28—**Sir Ernest Rutherford** and **J Chadwick** Energy relations in artificial disintegration Experiments on the disintegration of aluminium indicate that the change of energy is not the same for each nucleus, but that it may vary by so much as 5×10^6 electron volts Hence, either the mass of the aluminium nucleus or that of the nucleus formed in the disintegration may vary by nearly 0 006 mass units—**R H Fowler** An analogy for beams of particles of a reciprocal optical theorem due to Helmholtz—**D R Hartree** The distribution of charge and current in an atom with several electrons obeying Dirac's equations The approximation is made that each electron can be treated as in a stationary state in the field of the nucleus and the

remaining elections, and further that this field is spherically symmetrical An exact formula for the magnetic moment corresponding to a solution of Dirac's equation in a central field is given, and leads to Landé's g formula when 'relativity effects' are neglected —**N Feather** and **R R Nimmo** The distribution of range of the α particles from radium C′ and thorium C″ Distribution curves relative to 2134 α particles from thorium C′ and 729 from radium C′ showed that many more had ranges between 6 cm and 8 cm of standard air than was expected, and that the excess of short range particles was much greater in the former case than in the latter, where the results agreed satisfactorily with those of Briggs, obtained by the magnetic deflexion method —**R M Gabriel** Some further results concerning the integrals of moduli of regular functions along curves of certain types

PARIS

Academy of Sciences, Jan 28 **V Grignard** and **Tchéoufaki** The α diacetylene hydrocarbons Hydrocarbons of the type RC≡C–C≡CR can be obtained in good yields by the action of iodine in ether solution upon alkyl magnesium compounds, provided that the conditions laid down are closely followed In the fatty series, dipentine, dihexine, and diheptine have been prepared by this method, and several aromatic hydrocarbons of the same type are also described Phenyltriacetylene, $C_6H_5-C\equiv C-C\equiv C-C\equiv CH$, has also been prepared and its properties are given —**Serge Bernstein** Orthogonal polynomials —**Auguste Lumière, Mme R H Grange**, and **R Malaval** The pH of arterial blood and of venous blood Measurements by the electrometric method give pH values of 7 85 for arterial blood and 7 50 for venous blood The main cause of the variations appears to be the amount of carbon dioxide present —Georges Birkhoff was elected *correspondant* for the Section of Geometry in the place of the late Ivar Fredholm, and Adrien de Gerlache *correspondant* for the Section of Geography and Navigation in the place of the late Sir Philip Watts —**Maurice Fréchet** The distance of two contingent variables —**Lucien Féraud** Bundles of conjugated networks **Frank Loebell** The generalisation of a theorem of H A Schwarz —**Nicolas Cioranesco** The problem of Dirichlet for systems of equations of the elliptic type and the extension of a functional relation of M Hadamard —**A Gay** The movement of a cylinder in a viscous fluid —**Jules Baillaud** The determination of the galactic pole from the data of the selected areas —**L d'Azambuja** The use of the spectro heliograph for the determination of the level of the vapours of the reversing layer or lower portion of the solar atmosphere —**H Pélabon** Rectification by purely metallic bad contacts A description of the phenomena observed using as rectifier two similar steel cylinders separated by a thin layer of lycopodium powder or cork dust —**Henri Gutton** The effect of a magnetic field on the resonance phenomena in ionised gases —**P Salet** The constancy of the velocity of light Arguments against the application of the ballistic theory to the explanation of the changes in the intensity of light in certain stars —**E Darmois** The rotatory power of the tartrates of certain organic bases contribution to the study of strong electrolytes —**A Smits** The allotropic modifications of phosphorus Remarks supplementing the author's communication of Nov 29 last, and criticism of the work of Nicolaïeff on the same subject —**W Swietoslawski** A boiling point apparatus designed for researches under high pressures A modification of an apparatus previously described capable of being used under pressures up to 25 atmospheres —**A Zmaczynski** A new modification of a boiling point apparatus used for high pressures —**M Prettre** and **P Laffitte** The temperature of ignition of combustible gaseous mixtures The results given in an earlier paper on the temperatures of ignition of mixtures of air and hydrogen are much lower than those given by other workers, and this is attributed to the lower initial pressure adopted The present paper gives the result of the influence of the preliminary vacuum on the temperature of ignition —**Mlle Germaine Marchal** The action of silica, alumina, and of kaolin on barium sulphate **Mlle Jeanne Lévy** and **A Tabart** The relative affinity capacities of various radicals on the course of the isomerisation of the trisubstituted ethylene oxides —**P Fallot** The relations of the sub Betic with the Betic in the Sierras Tercia and Espuña —**H Pollet** Atmospheric electricity in the course of the sand storms of the north of China The electric charge on each dust particle is of the order of 100 times the elementary charge of an ion —**P L Violle** and **A Giberton** The neutralisation of the oligodynamic power of copper by solutions of electrolytes Application to mineral waters —**Georges Truffaut** and **G Thurneyssen** The influence of artificial light on the growth of the higher plants A description of the lighting arrangements by means of which normal beans and strawberries have been produced The microscopic examination of the leaves of the strawberry plants cultivated in artificial light showed that they were normally provided with chlorophyll and that their palisade tissues exactly resembled the normal palisade tissue of plants raised in daylight —**Charles Pontillon** The existence of resins in *Sterigmatocystis nigra* **J Manquené** The alluvial formations of western Algeria after the inundations of 1927 —**Lucien Daniel** The accentuation and persistence of symbiotic adaptations in the Jerusalem artichoke grafted on the annual sunflower —**Mlle G Fuchs, J Régnier, D Santenoise**, and **P Vare** A thyroid hormone regulating the cerebral excitability —**Paul Wintrebert** The liquefaction of the internal sheath of the egg in the urodelan Amphibia —**René Fabre** and **Henri Simonnet** The comparative study of the value of the biological test and the physical test of irradiated ergosterol It appears to be premature to attribute to the biologically active product a definite absorption spectrum **R Fosse** and **A Brunel** A new ferment This ferment, named allantoinase is found in various leguminous seeds and is characterised by its power of hydrolysing allantoin to allantoic acid

ROME

Royal National Academy of the Lincei, Nov 11 —**T Levi-Civita** The motion of a body of variable mass —**G Fubini** Further considerations on the transformations of Laplace, Lévy, and Moutard for hypersurfaces —**G Abetti** Anomalies of gravity and deviations of the vertical determined by the De Filippi expedition in Central Asia (1913–14) The results obtained by this expedition, taken in conjunction with those of the Survey of India to the south of the Himalayas and those of the Russian Geodetic Service in Turkestan and Pamir, show that on these mountain chains the gravitation constant is usually in excess To the south and to the north it is, however, usually deficient, this being an indication of the probable equality of the conditions of compensation or non compensation in the Indo-Ganges plain and in the plains of Turkestan —**F Vercelli** Experimental considerations concerning certain geo electric methods —**L Rolla** and **L Mazza** Concerning thallium photoelectric cells The procedure recently described by Majorana and Todesco for the preparation of thallium photoelectric cells

was published by Rolla in 1927 and has been patented Such cells have been successfully used by the Italian military authorities —**G Ascoli** The singularity of the solution in Dirichlet's problem A sufficient condition, not of purely geometrical character, but of ready applicability, is given for the validity of the theorem of singularity of the solution in Dirichlet's problem —**F Sbrana** A remarkable group of functional operators Some of the essential results are given of the author's recent investigations on the calculus of functional operators $f(\Delta)$ with $\Delta = \frac{\partial}{\partial t}$ and t variable and real This method of calculus, known as operational or symbolic calculus, is finding increasing application in the solution of numerous mathematical physical problems of industrial importance or inherent to modern atomic physics —**G Aliprandi** Determination of the principal triplet (terna)—of Vitali—of a generic surface, considered as an autopolar terna of the geodetic cone —**A M Bedarida** The algebraic bodies of Galois – **G Scorza Dragoni** Concerning a differential equation — **M Lelli** Bernoulli's theorem for homogeneous viscous liquids —**R Calapso** A new transformation of isothermal surfaces —**E Čech** Observations on the quadrics of Darboux — **G Sannia** New definitions of the canonical pencil – **M Maggini** Interferometric measurement of the effective wave length of double stars and its variation with the zenithal distance The interferometer is able to replace not only the micrometer where this is ineffective, but also the diffraction grating in the measurement of wave length, and the photometer in the measurement of extinction – **E Adinolfi** The influence of X rays on the structural conditions of bismuth and tellurium (3) When absorbed by bismuth during its solidification, X rays modify the structure of the metal, which exhibits a diminished Hall's coefficient and becomes electropositive towards ordinary solidified bismuth Under similar treatment, tellurium also assumes a lower Hall's coefficient, but is rendered electronegative with respect to ordinary tellurium When solidified rapidly from the molten state, both of these elements increase in hardness and acquire an increased specific heat, the latter change occurring also in the case of solidification under the influence of X rays – **O Occhialini** Low voltage sparks as spectroscopic sources The procedure to be adopted to obtain these sparks, which are formed at a voltage of 220, is described —**P Agostini** Heats of formation of double cadmium potassium chlorides The heats of formation of the compounds, KCl, $CdCl_2$, and $4KCl, CdCl_2$, are found to be + 3 65 (3 73) Cal and + 0 989 Cal respectively —**G Bargellini and Lydia Monti** α Phenylcoumarins Various α phenylcoumarins have been prepared by the condensation of aromatic *o* hydroxyaldehydes with substituted phenylacetic acids —**G Bargellini and P Leone** 3 5 – Dichlorophenetidine The best conditions for preparing this compound by passing hydrogen chloride through an alcoholic solution of nitrosophenol (Jaeger's method) are described, together with several of its derivatives —**G A Barbieri** New method for the volumetric determination of cobalt In the green liquids resulting from the decomposition of cobaltinitrites by hot sodium hydrogen carbonate solution, all the nitro groups of the cobaltinitrous complex are present as alkali nitrate, whilst the tervalent cobalt forms part of a cobalticarbonic complex, to which the green colour is due If the liquid is introduced into permanganate solution acidified with sulphuric acid, the nitrous acid is oxidised quantitatively in the cold to nitric acid and the tervalent cobalt is reduced to the bivalent form, so that eleven equivalents of oxygen are consumed for each molecule of the original cobaltinitrite These reactions serve as a basis for the volumetric determination of cobaltinitrites and hence of the two elements which can be separated quantitatively as cobaltinitrites, namely, potassium and cobalt – **G R Levi** Further investigations on catalysis with metals of the platinum group The catalytic decomposition of hydrogen peroxide by platinum is greatly influenced by the presence of other metals of the group Iridium and, to a less extent, rhodium depress the catalysis, and palladium seems to act similarly to iridium Possibly owing to a positive influence of the metal and a negative influence of the oxide, ruthenium is almost without effect on the catalysis Although the catalytic formation of sulphur trioxide is influenced only slightly and negatively by osmium, the decomposition of the peroxide is very markedly increased in the presence of this metal **G Piccardi** The Röntgen levels of the rare earths and the derivations from Moseley's law – **A Barchiesi** Ponderal and histophysiological investigations on guinea pigs and rabbits subjected to injections of lipoid mixtures Injection of lipoid mixtures affects all the organs and tissues examined and modifies the whole organic metabolism The results seem to support Serono's assumption that, possibly owing to their special chemical character, lipoids form biological catalysts which induce many complex reactions —**G Brunelli** Biophysical nature of the pitted erosion of the arenaceous rocks of the Tyrrhenian coast Observations made at Capo Linaro show that the perforation of the rocks is due initially to small shells of *Littorina punctata* and *L neritoides*, which attack the rock at the points of least resistance Afterwards the action of the waves affects further destruction of the rock in the perforations initiated by the molluscs, so that the degradation is of mixed, biophysical character In certain cases *Patella* also plays a part in this phenomenon —**S Ranzi** Relations between organogenetic and histogenetic processes (Investigations on experimental morphology in the cephalopods) Considerations of phenomena relating to the development of the embryos of cephalopods indicate that, up to a certain point, histogenetic processes are independent of organogenetic processes This general principle is in complete accordance with many data obtained from experiments on the culture of the tissues of vertebrates, these showing that, for varying but usually short periods, the cells may retain their differentiation **Aldo Spirito** Regulative processes of the encephalic region of the embryos of *Anura* — **T Terni** Regeneration and super regeneration of tissue and of organ in the tail of adult urodeles

SYDNEY

Linnean Society of New South Wales, Nov 28 — **G D Osborne** (1) The Carboniferous rocks between Glennies Creek and Muscle Creek, Hunter River District, N S W Comprise representatives of the Burindi Series, a marine series of Lower Carboniferous age, and the Kuttung Series, of Middle to Upper Carboniferous age, the latter are at least 8000 feet in thickness, and have been subdivided into the volcanic and glacial stages The late Palæozoic diastrophism produced a basin structure and associated broad folding Connected with this movement there developed a series of normal faults, one of which—the Brushy Hill Fault—is of great importance Separating the Carboniferous rocks from the Permian strata is a great fault—the Hunter Overthrust, which is of later date than the normal faults —(2) The Carboniferous rocks of the Muswellbrook Scone District, with special reference to their structural relations This area described

is to the north of that discussed above and has similar stratigraphical and tectonic features In the north west is the important Wingen fault, which cuts across the Hunter Overthrust It then strikes into the Carboniferous rocks, and is marked by a wonderful *shatter zone, up to five chains in width* —**J R Malloch** Notes on Australian Diptera No 18 An alphabetical catalogue of genera and species of Tachinidæ —**A B Walkom** Notes on some additions to the *Glossopteris* flora in New South Wales Descriptions of (1) a collection of small *Glossopteris* leaves which belonged to the late John Mitchell, (2) two terminal shoots (from the collection of the Geological Survey of New South Wales) which may possibly represent part of the plant which bore *Glossopteris* fronds, and (3) a collection of seeds belonging to Mr T H Pincombe Some of the latter resemble very closely seeds described from Upper Carboniferous and Permian rocks in Europe —**Frank A Craft** The physiography of the Wollondilly River Basin To the west of the Illawarra coast there is an area of plateau country forming the basins of the Wollondilly and Nepean Rivers Behind the coastal scarp over an extensive area this plateau has an elevation of 2000 2500 feet and is drained by the Eastern Wollondilly system and the Lower Shoalhaven This gives place in the west to a higher tableland, which rises from south to north The plateau as a whole presents a mature surface which is being cut up by stream erosion most markedly in the north

VIENNA

Academy of Sciences, Nov 29 —**E Smreker** Anastomoses between the dentine channels and cement corpuscles in the chamois —**K Menger** The semi constancy of arc length —**O Wettstein** Amphibia and reptilia from Palestine and Syria —**F Heritsch** Corals from the Carboniferous of the Yeitsch in Upper Styria —**H Hahn** Continuous extension images —**F Dehmer** Irreducible continua —**J B Niederl** and **R Casty** New condensations of ketones with phenols (2) Further cresol phorones

Dec 6 —**L Moser** and **O Brandl** The determination and separation of rare metals from other metals (13) Re examination of the gravimetric analysis of vanadium and two new methods for its determination There are several lead vanadates, under certain conditions first lead hexa vanadate and then lead pyro vanadate is formed Vanadic acid can be completely precipitated with mercury nitrate again under certain conditions —**L Moser** and **F List** (14) Separation of beryllium from the metals of the alkaline earths and from the metals of the ammonium sulphide and arsenic groups One way is by forming difficultly soluble metal tannic acid adsorption complexes, the other by hydrolysis of the beryllium ion by ammonium nitrite and methyl alcohol —**E Späth** and **N Polgar** A synthesis of non hydrated iso quinoline derivatives —**A Skrabal** The varieties of unstable intermediate substances in chemical kinetics The intermediates during the main period of the reaction may be in equilibrium with the initial or with the final substances —**F Hölzl** Buff s substance and Bunsen's salt Salts of tetrabasic hexa cyano ferric acid with alcohol as base —**W L Ayres** Generalisations of Jordan's continua —**G Bergmann** Axioms in elementary geometry —**B Finzi** Ants from Greece and the Ægean islands —**D W Adensamer** and **F Käufel** Land and fresh water mollusca from Greece and the islands of the Ægean —**H Strouhal** Land isopods from Greece and the islands of the Ægean —**H Preisner** Rhyncota from Greece and the islands of the Ægean

Dec 13 —**V Pietschmann** New species of fish from the Pacific Ocean —**F M Exner** Dune studies in the Courland sandhill tongue, with an appendix on river meanders, clouds, and cyclones arising from friction eddies Sand waves are explained by horizontal eddies Small sand waves move rapidly, larger waves slowly —**F Sigmund** and **R Uchann** The *catalytic splitting off of alcohol from acetals* (*preparation of unsaturated ethers*) By using a clay catalyser at 200° 250°, nickel not essential —**C Doelter** Reactions with blue rock salt —**C Zawisch-Ossenitz** The development of the human femur —**W Figdor** Cone-shaped leaves and the asexual multiplication of *Bryophyllum proliferum* —**K Fritsch** Observations on flower visiting insects in Styria, 1908 —**G Ortner** and **G Stetter** The use of electronic valve amplifiers for counting corpuscular rays —**E Guth** Systems of linear partial differential equations of the first order, compatible with a given metric, especially Maxwell's equations and Dirac's equations for the electron —**F Urbach** The form of the absorption and emission *bands in solids* —**A Zinke, W Hirsch,** and **E Brozek** Researches on perylene and its derivatives (19) —**K Funke, F Kirchmayr,** and **H Wolf** Researches on perylene and its derivatives (20) —**A Pongratz** and **E Pochmüller** Researches on perylene and its derivatives (21)

Official Publications Received

BRITISH

Report of the Commission on Closer Union of the Dependencies in Eastern and Central Africa. (Cmd 3234) Pp 354+5 maps (London H M Stationery Office.) 6s net.

Colonial Veterinary Service Report of a Committee appointed by the Secretary of State for the Colonies. (Cmd 3261) Pp. 44 (London H M Stationery Office) 9d net

The Scientific Proceedings of the Royal Dublin Society Vol 19 (N S), No 16 The Integration of Light by Photo-Electrolysis By Dr W R G Atkins and Dr H H Poole Pp. 159 164 6d Vol 19 (N S) No 17 A Note on Gas Analysis. By James T Donnelly C Hamilton Foott and J Reilly Pp. 165-172 6d (Dublin Hodges, Figgis and Co London Williams and Norgate Ltd)

The Proceedings and Transactions of the Nova Scotian Institute of Science Halifax, Nova Scotia Vol 17 Part 2 Session 1927-1928 Pp xi xix+40+lil (Halifax N S) 50 cents

International Federation of University Women Bulletin No 10 Report of the Twelfth Council Meeting, Madrid September 1928 Pp 108 (London)

Air Ministry Aeronautical Research Committee Reports and Memoranda. No. 1178 (Ae 342) The Change in Airscrew Characteristics with Height. By A. E Woodward Nutt. (T 2594 and a, revised) Pp 10+8 plates 9d net No 1175 (Ae. 339) An Analysis of a Rectangular Monoplane with Hinged Tips By S B Gates. (T 2578) Pp 10+8 plates 1s net. (London H M Stationery Office.)

Proceedings of the Fifteenth Indian Science Congress Calcutta 1928 (Third Circuit) Pp xxv+420 (Calcutta Asiatic Society of Bengal)

Transactions and Proceedings of the New Zealand Institute Vol 59, Part 3, September 1928 Pp iv+429-661+77 plates (Wellington, N Z)

Government of India Meteorological Department Magnetic, Meteorological and Seismographic Observations made at the Government Observatories, Bombay and Alibag in the Year 1923, under the Direction of Dr S K. Banerji Pp ii+72+5 plates (Calcutta Government of India Central Publication Branch) 8 8 rupees 14s. 3d

The Scientific Proceedings of the Royal Dublin Society Vol 19 (N S), No 15 William Higgins, a Pioneer of the Atomic Theory By Dr J Reilly and D T MacSweeney Pp 139-157 (Dublin Hodges, Figgis and Co London Williams and Norgate Ltd.) 1s.

Board of Education Educational Pamphlets, No. 32 The Admiralty Method of Training Dockyard Apprentices Revised edition Pp. 19 (London H M Stationery Office) 2d. net.

Madras Fisheries Department Fish Statistics for 1925-26. (Supplement to the Administration Report for 1926-27) Edited by Dr B Sundara Raj (Report No. 2 of 1928, Madras Fisheries Bulletin Vol 22) Pp. 76 (Madras Government Press.) 14 annas

Transactions of the Institution of Chemical Engineers Vol 5, 1927 Pp. 230 (London.)

FOREIGN

Carnegie Institution of Washington Eugenics Record Office Bulletin No. 26 Birth and Death Rates of the Feeble Minded By Charles V Green Pp 34 (Cold Spring Harbor, L I)

Collection des travaux chimiques de Tchécoslovaquie Rédigée et publiée par E Votoček et J Heyrovský sous le patronage de la Regia Societas Scientiarum Bohemica. Année 1, No. 1, Janvier Pp 64 (Prague)

Annalen v/d Bosscha-Sterrenwacht, Lembang (Java) Vol 2, 1ste Gedeelte Die südliche Milchstrasse Von A Pannekoek Pp. A73+6 Tafeln (Amsterdam Universiteit)

Pubblicazioni della Università Cattolica del Sacro Cuore Serie ottava, Statistica, Vol 2 Contributi del Laboratorio di Statistica, Serie Prima. Pp vii+436 (Milano Società Editrice "Vita e Pensiero") 50 lire.

Denkschriften der Schweizerischen Naturforschenden Gesellschaft (Memoires de la Société Helvétique des Sciences naturelles). Band 64 Abh 2 Nouveau Catalogue des moules d échinides fossiles du Musée d'Histoire Naturelle de Neuchâtel Exécutés sous la direction de L Agassiz et E. Desor par J Lambert et A. Jeannet. Pp. ii+88 288+2 planches Band 64, Abh 3 Zur Frage von der prähistorischen Besiedelung von Amerika mit allgemeinen Betrachtungen über die Stufenfolge der Steinzeit. Von Paul Sarasin. Pp 285 278+8 Tafeln (Zürich Gebrüder Fretz A.-G)

Report of the Secretary of the Smithsonian Institution for the Year ending June 30, 1928 (Publication 2978) Pp. vi+147 (Washington D C Government Printing Office)

Journal of the Faculty of Agriculture Hokkaido Imperial University Sapporo, Japan. Vol 25, Part 1 Dritter Beitrag zur Ichneumoniden Fauna Japans Von Toichi Uchida Pp. 115+8 Tafeln Vol 25 Part 2 The Chemical Studies on the Denaturation of Proteins. First Report, by Tetsutaro Tadokoro and Katsuji Yoshimura Second Report, by Tetsutaro Tadokoro and Shukichi Watanabe Pp 117 149 (Tokyo Maruzen Co , Ltd)

Japanese Journal of Mathematics Transactions and Abstracts Vol. 5, No 3 December Pp. 211 267 (Tokyo National Research Council of Japan)

Bulletin of the American Museum of Natural History Vol 58, Art. 3 The Nesting Habits of Wagler s Oropendola (Zarhynchus Wagleri) on Barro Colorado Island By Frank M Chapman Pp. 123-166+8 plates Vol 58 Art. 4 Diptera of the American Museum Congo Expedition By C H. Curran Pp 167 187 (New York)

Proceedings of the American Philosophical Society held at Philadelphia for promoting Useful Knowledge Vol 67 No 3 Pp 199-318 (Philadelphia.)

Department of Commerce U S Coast and Geodetic Survey Terrestrial Magnetism Serial No 428 Results of Magnetic Observations made by the United States Coast and Geodetic Survey in 1927 By Daniel I Hazard Pp 22. (Washington, D C Government Printing Office) 5 cents

State of Connecticut. Public Document No 24 Fifty first Report of the Connecticut Agricultural Experiment Station, New Haven Conn , for the Year 1927 Pp xi+821+xxvi. (New Haven, Conn)

Annual Report of the Director, United States Coast and Geodetic Survey to the Secretary of Commerce for the Fiscal Year ended June 30 1928 Pp iv+47+17 plates. (Washington, D C Government Printing Office) 75 cents

Contributions from the Jefferson Physical Laboratory and from the Cruft High Tension Electrical Laboratory of Harvard University for the Years 1926 and 1927 Vol 19 (Cambridge Mass.)

CATALOGUES.

Industrial Electric Furnaces with Automatic Temperature Control Pp. 12 (London Wild Barfield Electric Furnaces, Ltd)

Professor Coker s Photo-elastic Apparatus for determining the Distribution of Stress in Structural and Machine Members Pp 28 (London Adam Hilger Ltd)

The Case Hardening of Special Steels by Nitrogen Pp. 31 (Sheffield Nitralloy, Ltd)

Laboratory Fittings for all Classes of Scientific Research (List F) Pp. 16 Electrically Heated Laboratory Apparatus. (Pamphlet No 231E) Pp. 16 Comprehensive List of Scientific Text Books. Pp 12 (London A Gallenkamp and Co , Ltd)

Diary of Societies

FRIDAY, MARCH 8.

ANDERSONIAN CHEMICAL SOCIETY (at Royal Technical College, Glasgow), at 8 15 —W H Nuttall Rubber and its Commercial Applications

ROYAL SOCIETY OF ARTS (Indian Meeting), at 4 30 —W H Moreland The Indian Peasant in History

ROYAL ASTRONOMICAL SOCIETY, at 5 —Prof S. Chapman Solar Streams of Corpuscles their Geometry, Absorption of Light, and Penetration —N Goryatscheff Occultations of Stars by the Moon, observed at the Tomsk University Observatory during the Year 1928.—Prof S. Chapman and V C A Ferraro The Electrical State of Solar Streams.—Y Ohman Astronomical Consequences of the Polarisation of Fluorescence —W H McCrea The Hydrogen Chromosphere —C L. Janssen Provisional Elements of the Binary System β G C 12307

IMPERIAL COLLEGE CHEMICAL SOCIETY (in Main Chemistry Lecture Theatre, Royal College of Science), at 5 —Dr N V Sidgwick Chemical Linkage

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section) (Clinical Meeting at University College Hospital), at 5

PHYSICAL SOCIETY (at Imperial College of Science), at 5 —Dr E Griffiths and J H Awbery The Dependence of the Mobility of Ions in Air on the Relative Humidity —Prof A M Tyndall Some Unsolved Problems relating to the Mobility of Gaseous Ions—followed by a General Discussion on the Mobility of Ions

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 —Sir Arthur Keith Demonstration on the Anatomy and Pathology of 'Diverticulitis

ROYAL SOCIETY OF MEDICINE (Clinical Section), at 5 30

SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (Annual Meeting) (at Liverpool University), at 6.—L. O Newton Boiler Feed Water

MALACOLOGICAL SOCIETY OF LONDON (in Zoological Department, University College), at 6

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7 —J A Hall Bromide Papers.

MANCHESTER ASSOCIATION OF ENGINEERS (at Engineers Club Manchester), at 7 15 —F B Holt Improvements in Driving Textile Mills

BLACKBURN TEXTILE SOCIETY (at Blackburn Technical College), at 7 30.—J H Place Dobbies.

JUNIOR INSTITUTION OF ENGINEERS, at 7 30.—S. H Hole Road Transport (Chairman s Address)

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY (jointly with Leicester Association of Engineers) (at Secular Hall, Leicester), at 7 30.—Dr J Newton Friend Science in Antiquity

INSTITUTE OF METALS (Sheffield Local Section) (at Sheffield University) at 7 30 —W S. Gifford Progress in Electric Furnaces

OIL AND COLOUR CHEMISTS ASSOCIATION (Manchester Section) (at Milton Hall Manchester), at 7 30 —S. T Kinsman The Fastness to Light of Lake Colours.

TEXTILE INSTITUTE (Lancashire Section) (at Manchester), at 7 30 —L. G Lawrie The Microscopical Investigation of Textile Fibres and Fabrics

INSTITUTE OF TRANSPORT (Newcastle-upon Tyne and District Section) (at Y M C A Hall, Newcastle-upon Tyne), at 7 30.—E McClelland Some Aspects of Selling Rail Travel

KEIGHLEY ASSOCIATION OF ENGINEERS (at Keighley), at 8 —A. G Springfield Centrifugal Castings

ROYAL INSTITUTION OF GREAT BRITAIN, at 9 —Prof T F Tout The Place of Women in Later Medieval Civilisation

SATURDAY, MARCH 9

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (Yorkshire District) (at Town Hall Sheffield), at 3 —W J Hadfield The Local Government Act and the Municipal Engineer

BRITISH PSYCHOLOGICAL SOCIETY (General Meeting) (at Royal Anthropological Institute) at 3 —Prof T H Pear and Miss Edna M Henshaw Some Subtler Skills Conditions for Improvement in Manual Dexterity

ROYAL INSTITUTION OF GREAT BRITAIN at 3 —Sir Ernest Rutherford Molecular Motions in Rarefied Gases (II).

MONDAY, MARCH 11

CAMBRIDGE PHILOSOPHICAL SOCIETY (in Cavendish Laboratory), at 4 30 —N F Mott Quantum Theory of Electronic Scattering in Helium —H M Cave Note on the Number of High Velocity β rays —J L. Hamshere The Mobility Distribution and Rate of Formation of Negative Ions in Air —W Georgeson Thermionic Emission through Double Layers —*Papers to be communicated by title only* —Dr C F Sharman Secondary Electron Emission from Solid Metal Surfaces —J G Semple On Certain Loci of Three Dimensions Representable on Ordinary Space by Means of Cubic Surfaces, and the Cremona Transformations for Ordinary Space obtained by Projection of such Loci.—G de B Robinson A Geometrical Study of the Alternating and Symmetric Groups —G Redington The Effect of the Duration of Light upon the Growth and Development of the Plant —Prof F E Fritsch Evolutionary Sequence and Affinities among Protophyta —M Robertson Life Cycles in the Protozoa.

ROYAL GEOGRAPHICAL SOCIETY (at Lowther Lodge), at 5 —Rear Admiral H P Douglas Echo Sounding

ROYAL SOCIETY OF MEDICINE (War Section), at 5 —Surg -Comdr H Hill Post-encephalitis and its Problems in the Service

ROYAL COLLEGE OF SURGEONS OF ENGLAND at 5 — C E Shattock Demonstration on Specimens illustrating Diseases of the Kidneys

BRITISH PSYCHOLOGICAL SOCIETY (Education Section) (at London Day Training College), at 6 —Norman Angell Teaching Economics by Visual Demonstration

TEXTILE INSTITUTE (London Section) (at Clothworkers Hall) at 6 —Dr W Gibson Research Work as an Aid in the Sale of Linen Products

INSTITUTION OF AUTOMOBILE ENGINEERS (Birmingham Centre) (at Queen s Hotel Birmingham) at 7 —K Thomas Some Investigations into the Performance of Tubular Radiators for Motor Vehicles

INSTITUTION OF ELECTRICAL ENGINEERS (North Eastern Centre) (at Armstrong College Newcastle upon Tyne), at 7 —Ll. B Atkinson How Electricity does Things (Faraday Lecture).

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associate Members and Graduates Branch) (at Borough Polytechnic), at 7 —J H Bryant Sprinklers

SOCIETY OF CHEMICAL INDUSTRY (Yorkshire Section) (at Hotel Metropole Leeds), at 7 15 —Prof C H Desch The Nature of Hardness.—H O Neill The Hardness of Metals

CERAMIC SOCIETY (at Stoke-on Trent), at 7 30 —F H Rogers Factory Floors.

INSTITUTE OF METALS (Scottish Local Section) (at 39 Elmbank Crescent, Glasgow) at 7 30 —Open Discussion

MEDICAL SOCIETY OF LONDON (at 11 Chandos Street W), at 8 30 —Dr R. Miller and Dr W G Wyllie Chronic Dyspepsias of Children over the Age of Infancy

INSTITUTION OF ELECTRICAL ENGINEERS (Western Centre) (at Cardiff)

TUESDAY, MARCH 12

ROYAL SOCIETY OF MEDICINE (Psychiatry Section) (Clinical Meeting at Maudsley Hospital) at 4 30

ROYAL SOCIETY OF MEDICINE (Therapeutics Section) at 5.—Dr G Linder and Dr C F Harris Treatment of Chronic Tetany with Steatorrhœa in Adults.

ROYAL COLLEGE OF PHYSICIANS OF LONDON at 5 —Prof E B Verney Polyuria (II).

ROYAL INSTITUTION OF GREAT BRITAIN at 5.15 —Dr S. W Kemp Antarctic Whaling Expeditions (I)

INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5 30

INSTITUTE OF MARINE ENGINEERS, at 6.30 —Dr E V Telfer Merchant Ship Service Performance Analysis.

INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at North British Station Hotel Edinburgh) at 7 —J Wright and C W Marshall The Construction of the Grid Transmission System in Great Britain

INSTITUTION OF AUTOMOBILE ENGINEERS (London Graduates) (at Watergate House, Adelphi), at 7 25 —D Swallow Metal Omnibus and Car Bodywork

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND (at 39 Elmbank Crescent, Glasgow), at 7 30 —Eng Capt. J C Braud Pulverised Fuel To-day

QUEKETT MICROSCOPICAL CLUB, at 7 30 —Dr Philippa Esdaile Some Household Pests

PHARMACEUTICAL SOCIETY, at 8 —Sir Herbert Jackson The Nature of the Changes which take place in Various Forms of Glass (Lecture)
ROYAL ANTHROPOLOGICAL INSTITUTE, at 8 30 —L Abbé Breuil Essai de co ordination des faits géologiques relatifs aux industries paléolithiques anciens au sud et sud est d Angleterre.

WEDNESDAY MARCH 13

INSTITUTE OF METALS (Annual General Meeting) (at Institution of Mechanical Engineers), at 10 A M —Prof P Saldau Special Properties of Eutectics and Eutectoid Alloys in Binary Metallic Systems.—F Hargreaves and R J Hills Work softening and a Theory of Intercrystalline Cohesion —G B Brook and G H Stott The Testing of Electro-deposits on Aluminium —At 2.—Dr P J Durrant The Constitution of the Cadmium Rich Alloys of the System Cadmium Gold —D Marie I V Gayler and G D Preston The Age hardening of some Aluminium Alloys —C Blazey Brittleness in Arsenical Copper (II).—Dr P J Durrant The Haughton Hanson Thermostat A Method of Flue Adjustment —Dr W Hume Rothery and E Rounsefell The System Magnesium-Zinc
NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section) (Newcastle upon Tyne) at 7 15 —M Waters The Problem of High Voltage Measurement
HALIFAX TEXTILE SOCIETY (at Halifax) at 7 30 —J H Edmundson Treatment for Trade Effluent from Textile Trades
ROYAL SOCIETY OF ARTS, at 8 —R. P G Denman Loud Speakers
SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) (jointly with Royal Philosophical Society of Glasgow) at 8 —Dr J A Cranston Bicentenary Address on Joseph Black
EUGENICS SOCIETY (at Linnean Society), at 8 —Dr Margaret Rorke and Mr Weatherall Heredity in Education
ELECTROPLATERS AND DEPOSITORS TECHNICAL SOCIETY (at Northampton Polytechnic Institute) at 8 15 —J W Perring Electroplating Plant
INSTITUTE OF FUEL —F W Goodenough The Industrial Use of Gas
HASLINGDEN DISTRICT TEXTILE SOCIETY (at Grammar School Haslingden). —C A Harrington The Weaving of Artificial Silks

THURSDAY, MARCH 14

INSTITUTE OF METALS (Annual General Meeting continued)(at Institution of Mechanical Engineers) at 10 A M —H C Lancaster The Importance of Design and Setting of Large Kettles used for Refining and Low Melting Point Alloys - Dr W Rosenhain and W E Prytherch An Improved Form of Electric Resistance Furnace —Dr F Campbell Recent Developments in Electric Furnaces —At 2 —C Sykes Alloys of Zirconium (II).—Dr J Newton Friend and W E Thorneycroft The Resistance of Zinc to Indentation (A Preliminary Account) —Dr J Newton Friend The Solution of Plain and Amalgamated Zincs in Electric Batteries —Dr J Newton Friend and W E Thorneycroft The Silver Contents of Specimens of Ancient and Medieval Lead
ROYAL SOCIETY at 4 30 —Discussion on Ultramicroscopic Viruses infecting Animals and Plants (continued)
IMPERIAL COLLEGE CHEMICAL SOCIETY (in Main Chemistry Lecture Theatre Royal College of Science) at 5 —Prof C K Ingold The Significance of Tautomerism
LINNEAN SOCIETY OF LONDON at 5 —Dr E J Allen The Origin of Adaptations (Hooker Lecture)
LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society) at 5 — N S Koshliakov Note on the Remainders in the Asymptotic Expansions of Bessel Functions —J E Littlewood The Quadratic Equation in Quaternions.—C E Walsh The Multiplication of Certain Series
ROYAL COLLEGE OF PHYSICIANS OF LONDON at 5 —Prof E B Verney Polyurin (III)
ROYAL INSTITUTION OF GREAT BRITAIN at 5 15 —Rev W H Draper The Handling and Interpretation of Metaphor
INSTITUTE OF CHEMISTRY (Liverpool and North Western Section) (at Liverpool University) at 6 —R. B Pilcher Alchemists in Art and Literature
INSTITUTION OF ELECTRICAL ENGINEERS at 6 —T N Riley and T R Scott Electrical Insulating Papers for the Manufacture of Power Cables — S G Brown and P A Sporing The Prevention of Ionisation in Impregnated Paper Dielectrics
ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6 30 —Wing Comdr G B Hynes Engine Performance Tests
SOCIETY OF CHEMICAL INDUSTRY (Birmingham and Midland Section) (Annual Meeting) (at Engineers Club Birmingham), at 7 —The Chairman and others Miscellany
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Colour Group) (Annual General Meeting), at 7
WEST CUMBERLAND SOCIETY OF CHEMISTS (at Workington) at 7 —Dr Briggs The Preparation of Coal for Sale
OPTICAL SOCIETY (at Imperial College of Science) (Annual General Meetings) at 7 —At 8 —Ordinary Meeting.—W D Wright A Re determination of the Trichromatic Coefficients of the Spectral Colours —Dr J S Anderson On the Testing of a Novel Photographic Shutter
INSTITUTION OF ELECTRICAL ENGINEERS (Dundee Sub-Centre) (at University College Dundee) at 7 30 —W Woodliwiss Distribution
ROYAL SOCIETY OF MEDICINE (Neurology Section) at 8 30 —Cinematograph Demonstration of a Film showing Work on Conditioned Reflexes in Prof Pavlov s Laboratory Leningrad
BRITISH INSTITUTE OF RADIOLOGY, at 8 30

FRIDAY MARCH 15.

ASSOCIATION OF ECONOMIC BIOLOGISTS (in Botanical Lecture Theatre Imperial College of Science and Technology) at 2 30 —Sir John Russell Some Agricultural Problems in Australia.—F L McDougall The Commonwealth Council of Science and Industry in its Relation to Agriculture.
ROYAL ASTRONOMICAL SOCIETY (Geophysical Discussion), at 4.30 — Thunderstorms and the Maintenance of the Earth s Electric Field Chairman, Prof S. Chapman Discussion to be opened by Prof E V Appleton and continued by R. A. Watson Watt, Dr G C Simpson Prof C T R Wilson and T W Wormell
BIOCHEMICAL SOCIETY (Annual General Meeting) (in Department of Physiology and Biochemistry, University College), at 4 30 —I S. MacLean Further Observations on the Sterols of Yeast.—H J Channon and A C Chibnall The Isolation of n nonacosane and di n tetradecyl Ketone from Cabbage Fat —J G Davis and A T R. Mattick The Metabolism of a Pigmenting Anaerobic Bacterium.—G N Richardson and R K. Cannan Reaction of Azine Compounds with Proteolytic Enzymes —B C Guha and Prof J C Drummond Observations on the Concentration of Vitamin B_1 —Prof J C Drummond R. A Morton and K H Coward A Critical Examination of the Methods for the Assay of Vitamin A.—C R Harington and S S Randall Isolation of 3 5 diiodotyrosine from the Thyroid Gland
MEDICAL OFFICERS OF SCHOOLS ASSOCIATION (Annual General Meeting) (at Society of Medical Officers of Health, 1 Upper Montague Street) at 5 — Sir Henry Gauvain The Combined Education of Children Suffering from Physical Defects
BRITISH INSTITUTE OF RADIOLOGY (Medical Meeting) at 5 — Urinary Discussion
ROYAL COLLEGE OF SURGEONS OF ENGLAND at 5 —Sir Arthur Keith Demonstration of Recent Advances in our Knowledge of the Anatomy and Physiology of the Gall Bladder
BRITISH PSYCHOLOGICAL SOCIETY (Esthetics Section) (at Bedford College) at 5 30 —Mrs Roberts (Susan Miles) and others Discussion on Inspiration
SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (Annual Meeting) (at Liverpool University), at 6 —L O Newton Boiler Feed Water
NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Newcastle upon Tyne), at 6.—J H Gibson Mechanical and Transmission Losses in Marine Engines Shafting and Propellers
INSTITUTION OF ELECTRICAL ENGINEERS (London Students Section), at 6 15 —C F J Morgan Wave form Analysis.
SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Cardiff Technical College), at 7 —Annual General Meeting
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group) at 7
SOCIETY OF DYERS AND COLOURISTS (Glasgow Section) (at 7 Gordon Street Glasgow), at 7 15 —F Asquith The Necessity of Application of Fast Colours on Textile Fabrics
JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7 30 —T Grime Locomotive Rating
ROYAL INSTITUTION OF GREAT BRITAIN at 9 —Prof V M Goldschmidt The Distribution of the Chemical Elements
SOCIETY OF DYERS AND COLOURISTS (Manchester Section) —Short Papers

SATURDAY MARCH 16

ROYAL INSTITUTION OF GREAT BRITAIN at 3 —Sir Ernest Rutherford Molecular Motions in Rarefied Gases (III)
GEOLOGISTS ASSOCIATION (North East Lancashire Group) (at Blackburn Technical College) at 7 —J Ranson The Evolution of the Craven Highland
PHYSIOLOGICAL SOCIETY (Annual General Meeting) (at University College).

PUBLIC LECTURES

FRIDAY MARCH 8

KING S COLLEGE at 5 30 —C J Gadd Assyrian Studies in the Present and Future
SURVEYORS INSTITUTION at 5 30 —Prof J S Huxley Heredity and Society (delivered in connexion with the Institution of Professional Civil Servants).

SATURDAY MARCH 9

HORNIMAN MUSEUM (Forest Hill), at 3 30 —R W Sloley The Cave Artists of the Stone Age

MONDAY MARCH 11

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE at 5 30 —Prof F Fulleborn Some Biological and Epidemiological Aspects of Helminthic Infection (Succeeding Lectures on Mar 12 and 18.)
EAST ANGLIAN INSTITUTE OF AGRICULTURE (Chelmsford) at 7 — F R. Petherbridge The Spraying of Fruit Trees.
ROYAL SOCIETY OF ARTS, at 8. —G Mowlem Burt The Making of a Modern Building with Cinema Illustrations (Bessom Gift Chadwick Lecture)

THURSDAY, MARCH 14

FARADAY SOCIETY (at Chemical Society), at 2 30 —Prof V M Goldschmidt Crystal Structure and Chemical Constitution and General Discussion on same subject by Dr W T Astbury, Dr J D Bernal Sir W H Bragg Prof W L Bragg Prof P P Ewald, Prof F M Jaeger, Dr N H Kolkmeijer Mrs K Lonsdale Prof T M Lowry Dr H Mark Dr A Muller Dr H S Piper F I G Rawlins Prof A Reis, Prof E Schiebold Dr K Weissenberg and Prof A Westgren

SATURDAY, MARCH 16

HORNIMAN MUSEUM (Forest Hill), at 3 30 —J E S Dallas Saxon Churches and their Remnants

Editorial and Publishing Offices

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SATURDAY, MARCH 16, 1929

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No 3098, Vol 123]

The Natural History Museum at South Kensington

ZOOLOGISTS, by an overwhelming majority in open meeting, have expressed their sense of dissatisfaction at the present system of control of the British Museum of Natural History, which is mainly devoted to their science, and is regarded by them as their place of reference for all questions relating to the different species of animals This Museum is a branch of the British Museum, the home of which is at Bloomsbury, its chief func tion being the care of art and ethnological collec tions and the maintenance of a Library It is governed by a Board of fifty one Trustees, of whom the Archbishop of Canterbury, the Lord Chancellor, and the Speaker of the House of Commons are Principal Trustees [1] There is also a trustee appointed by the Sovereign, and twenty four official trustees Among these are the president of the Royal Society and the president of the Royal College of Physicians—the sole representatives of the natural sciences There are in addition nine representatives of families whose magnificent gifts have enriched the State Several distinguished men of science are included, however, among fifteen trustees 'elected' by their colleagues on the nomination of the principal trustees

The trustees act through a standing committee of twenty members, which meets ten times a year at Bloomsbury and eight times at South Kensing ton This committee consists largely of the elected trustees "appointed because they are known to be interested in the work as well as competent," and it guides the administrative business of each museum in an efficient manner The direction, however, of a museum of natural history is very different from that of a picture gallery or an art museum the problems which come before the governing body for solution require, therefore, a different kind of knowledge, and unless governed on different lines, neither institution can achieve full success or have full scope for development Indeed, it is obvious that the policy of the Natural History Museum is controlled by its director, and his duty—to maintain its collections—necessitates the choice of a systematic specialist, a side in creasingly separating year by year from university and industrial research To assist the director effectively, he requires a representative body of naturalists and industrialists as trustees , and such

[1] A full account of the method of governing the Museum is given in the very interesting Memorandum presented by Sir Frederic Kenyon to the Royal Commission on National Museums and Galleries and printed in the volume of evidence, p. 51

a body would not have the requisite knowledge or interest for the care of the priceless collections at Bloomsbury

Under these conditions it is necessary to consider the advisability of severing the bonds which bind the two sides of the British Museum together The director of the British Museum is the head accounting officer for both, and hence alone has access to the Treasury While preserving their connexion and governance, a separate accounting branch for the Natural History Museum was offered, but its then director refused, not wishing to be troubled while he had a building free from congestion, and a science at that time scarcely connected, even remotely, with public health and industry This change might be made now, but, while certainly beneficial, does not go to the root of the matter Rightly or wrongly, naturalists have shown their dissatisfaction with the present arrangements by repeated memorials to the Government of the day during the last sixty years In 1866, while the collections were still housed at Bloomsbury, they presented a memorial to the Chancellor of the Exchequer in which they state their view in clear terms "We are of opinion that it is of fundamental importance to the progress of the Natural Sciences in this country that the administration of the National Natural History Collections should be separated from that of the Library and Art Collections, and placed under one officer who should be immediately responsible to one of the Queen's Ministers" To this memorial twenty five signatures only were appended, but they were those of the foremost naturalists in the country, Charles Darwin, Huxley, Hooker, Lord Lilford, Wallace, and others—men of international renown

The Royal Commission on Scientific Instruction and the Advancement of Science took evidence on this matter with great care The commissioners summarise the evidence they received by expressing their opinion in 1874, "that the objections to the present System of Government of the British Museum by a Board of Trustees, as at present constituted, so far as relates to the Natural History Collections, are well founded, and we have been unable to discover that the system is attended by any compensating advantages" They recommended that the director "should be appointed by the Crown and under the control of a Minister of State, to whom he should be immediately responsible" They also suggested an expert Board of Visitors, the members of which should be appointed for a limited period, but be re eligible, and who should make annual reports to the Minister, to be laid before Parliament

Nothing was done, and the Council of the British Association in 1879, a bill having been passed in the previous session to authorise the trustees to transfer the Natural History Collections into the new building at South Kensington, without any reference to a separation in governance, memorialised the First Lord of the Treasury to this end, but without effect The superintendent of the Natural History Museum was made director in 1885 with a comparative independence, which was revoked in 1898 In 1908 a deputation, representative of zoology, botany, and geology, was received by the Prime Minister (Mr Asquith) and asked for a full official inquiry into the organisation of the Natural History Museum This was refused, as the trustees are a statutory body with whom the Government is powerless to interfere, an extraordinary position for a Prime Minister He sympathised with the view that the director should have a free hand in the management of his department, and promised to convey to his fellow trustees of the British Museum all that the deputation had suggested No alteration, however, was made

In the meantime zoology has advanced by leaps and bounds It is no longer a subject of purely philosophical interest That the facts of heredity in man and animals are vital to the due governance of any State is now clear Fisheries to a large extent depend on the study of the development of fish and of their habits at different ages in relation to the physical and chemical conditions of the water in which they live The study of wools, silks, and hides has materially affected important industries, and all breeding is carried on for specific ends, for food, for transport, or for raw products of manufacture The microscopical study of unicellular animals has resulted in the amelioration of the lot of mankind in respect to malaria and many other diseases, and scientific measures are in force over a large part of Africa against sleeping sickness The Imperial Bureau of Entomology has its centre in the Natural History Museum, much of its work based on the national collections, and especially cares for crops so far as insect and other attacks are concerned Many molluscs are valuable as food, some for their shells, and the study of corals and marine plants is necessary in respect to navigation in the tropics Indeed, there is to day the recognition that the study of animals is vital to man's civilisation and progress, and all our colonies employ specialists to apply the laws of their science

These laws are largely the aims in research at the universities, the understanding of the structure in relation to the manifold activities of the living matter upon which all organisms depend The two sides of this and of all sciences are inextricably bound, for progress in understanding must always precede scientific application

Representatives of all these aspects of animal life look to the Natural History Museum to catalogue and to store specimens for reference, and there is not a single group which is free from their activities All animals have fundamental points of relationship, and it is commonly essential for an investigator to have to refer to a dozen or more forms in as many groups They are vitally interested in the Natural History Museum, and they cannot agree, to day, with Mr Asquith in 1908, that the trustees are "equally cognisant of natural history and archæology" in the sense of knowledge of the needs of scientific and applied zoology They do not see how due representation of their present and future aims can be given without such a large increase in the body of trustees as to amount to a complete reconstruction They consider that the Museum in future will have to extend its activities into the field and to collect the animals it requires, if it is to maintain its utility A director brought up within its walls for twenty or thirty years will even, in the next decade, be necessarily out of touch with his fellow zoologists outside, yet it would be deplored if his post, which should be the ambition of every member of the staff, should on a vacancy be filled necessarily from outside

With these views scientific men generally find themselves in cordial agreement They ask for no exceptional treatment, only for their affairs to be managed by a board of governors, which may be divided into those who have knowledge and judgment in respect to their activities, and those who are interested in the successful prosecution of such for national ends We feel that there is no reason to perpetuate any form of governance by trustees or otherwise, if a better method can be devised Evolution is equally a law in organic science and in national affairs, and for the welfare of both, progress is essential No State is wise to refuse inquiry if any class of its subjects clearly demands it, and there seems to be practical unanimity here Fortunately, a suitable body for such investigation is in existence—the Royal Commission on National Museums and Galleries, and the evidence submitted is so cogent and suggestive that we are confident it will lead to constructive conclusions

British Floods and Droughts

British Floods and Droughts By Dr C E P Brooks and Dr J Glasspoole With an Introductory Note by Dr Hugh Robert Mill Pp 100 +2 plates (London Ernest Benn, Ltd, 1928) 10*s* 6*d* net

THIS book will attract many readers by its title, and they are not likely to be disappointed in its contents, which embrace entertaining accounts of notable floods and droughts in the British Isles back to quite early times, together with a wealth of statistical data about rainfall fluctuations compressed into a comparatively small volume In the rain rich climate of the British Islands, flooding is perhaps a more familiar condition than one of drought, but, as the authors truly observe, the vicissitudes neither of one nor the other are anything but mild compared with what occur in many other countries In fact, it would be true to say that the climate of these islands is well balanced or even tempered, not in spite of its variability but because of it, inasmuch as excesses in any direction rarely last long enough to pass from the stage of an entertaining diversion from the monotony of normal conditions into that of serious distress and danger In other words, the weather here provides plenty of stimulus, physical and mental, at a smaller cost in life and suffering than is the case in some parts of the world

After an introduction on the general subject of rainfall in the British Isles, Dr Brooks and Dr Glasspoole, experts in this subject, arrange the fourteen chapters of their book into three parts I Great Rains and Floods, II Droughts, III Variations of Rainfall British floods are of several types The most familiar floods are the widespread, slowly rising river valley floods that may follow excessive rainfall at any season of the year, but most frequently in winter when melting snow may also be a factor The great Thames floods of November 1894, the Severn floods of May 1886, the Tees floods of September 1927, the Norwich floods of August 1912, the destructive thaw floods in the Scottish Highlands of January 1892, the historic Morayshire inundations of August 1829, are all outstanding examples of this class of flood The Norwich flood forms the subject of the frontispiece It was caused by a cyclonic downpour yielding 8 inches of rain in 24 hours on the top of previous heavy rains

Floods of the 'cloud burst' type in association with summer thunderstorms are more localised but also more dangerous, for they rise suddenly

when 5 or more inches of rain come down in a few hours of storm, and the water seems to fall in a solid sheet The Louth disaster of Whitsuntide 1920, when 22 persons were drowned, as a great thunderstorm burst over the Lincolnshire Wolds, was of this character A similarly impressive storm took place at Driffield at the foot of the Yorkshire Wolds on July 3, 1892 Cloudbursts, however, have been peculiarly prolific in the mountainous districts of South Wales and along the bold Pennine-Cheviot backbone of northern England On July 2, 1893, one such storm bursting over the wilds of the Cheviots ploughed up many acres of black peat on the desolate fellside of Bloodybush Edge, Northumberland

Of tidal floods, the most serious of modern times was that of Jan 6, 1928, on the east coast and up the Thames estuary, taking toll of fourteen lives in London It was due to the combined factors of a spring tide, a severe gale in the North Sea, and an upper Thames charged with snow water In the Middle Ages when, according to Prof Otto Pettersson, both the tide raising forces and the storminess were at a maximum, tidal floods caused enormous devastation and loss of life on the North Sea coast both of England and Holland We have also floods due to the failure of dams, as when 245 lives were lost by the bursting of the Bradfield Reservoir, near Sheffield, on Mar 11, 1866

British droughts appear to have been severe in the eighteenth century, but in modern times the worst droughts of a protracted character were probably those of 1887 in the north west of England and 1921 in the south east, when there was a great dearth of water and milk in many districts The great spring drought of 1893, however, was more acute while it lasted, many places in Kent and Sussex, as well as London, experiencing two or more absolutely rainless months Dry weather, while it lasts, can be very intense in the wet western parts of the British Isles, but it has more definite bounding dates without the periods of faltering rainfall before and after, which are sometimes so pernicious in the dry eastern parts

The book contains useful information about the extreme variations of rainfall since the establishment of reliable rainfall records on an extensive scale, that is, from about 1870 Thus the highest annual rainfall total on record is 247 inches at the Stye Head, Cumberland, in 1923, and the lowest, 10 inches, at Margate, in 1921 , but the latter year was only the driest in the south east of England, whilst the former was nowhere near the wettest over the British Isles generally The highest two daily totals, close to 9½ inches, both, curiously enough, belong to Somerset, the one case at Bruton on June 28, 1917, and the other near Bridgwater on Aug 18, 1924 The longest duration of *absolutely* continuous rainfall, namely, 58½ hours, is on record for Camden Square, London, between 1 P M on June 11 and 11 30 P M on June 13, 1903 As the duration of continuous rain is an interesting and important aspect of climate, it is to be regretted that the authors do not warn their readers that the number of self recording rain gauges is relatively small, and that it is unlikely that London really holds such a record In the hill districts of Britain where the rainfall is excessive, bad weather is often of a most unrelenting character Rain that will cease for an interval in the plains has there a way of simply altering its character, of changing its tune, so to speak, from heavy driving sheets to a teasing, drenching drizzle, and back again, and it is highly probable that in the high hills sixty or more hours of continuous rain is not very uncommon

The methods adopted by the authors for estimating the rainfall of the country to a good approximation in earlier periods when rain gauges were few are ingenious, whilst their treatment in the last chapter of the study of weather periodicities and recurrences is cautious but suggestive The periodic component in the make up of the weather is, as Capt Brunt has shown, small, and of very little use in forecasting , but the curves produced by Drs Brooks and Glasspoole permit of a hope, though not a forecast, that the tide is about to turn, and that the wet spell of years that has marked the first quarter of the century, and especially the last six years, will soon be broken, with a tendency to finer summers May we say, however, that we think the authors have been a little too insistent in their emphasis on the dismal side of rainy summers like 1924 and 1927 ? Excessive summer rains are admittedly inconvenient and may worry the farmer, but they bestow lavish beauty upon earth and sky and play no small part in the making of " England's green and pleasant land " The form and lighting of the clouds and the wild and fantastic sunsets in a rainy summer are incomparable ! Moreover, there are always plenty of delightful intervals and ideal days in the worst of summers if people would only choose to see them, and in this connexion the authors rightly point out that the wet August Bank Holiday of 1927 gave the whole summer a reputation which it did not deserve

L C W BONACINA

Scottish Ornithology

The Geographical Distribution and Status of Birds in Scotland By Evelyn V Baxter and Leonore Jeffery Rintoul Pp vii + 425 (Edinburgh and London Oliver and Boyd, 1928) 15s net

THE feathered population of the British Isles has been subjected of late years to scrutiny so intense as to cause misgiving, and in some cases indignation, among such lovers of birds as are not specialists

The conditions necessary for the satisfaction of the scrupulous framers of ornithological statistics imply the slaughter, euphemistically termed the 'collection' or 'securing,' of very many harmless birds In the *Zoologist* for January 1913, Dr C J Patten, in discussing the reported occurrence of four Redbreasts, *Erithacus rubecula*, at the Tuskar Lighthouse, remarked "The birds were not captured, and so these occurrences cannot carry the same weight that they would had the specimens been secured and forwarded for corroboration "

In their volume on "The Geographical Distribution and Status of Birds in Scotland," Miss Baxter and Miss Rintoul are at pains to distinguish between the British and Continental forms of several species In regard to the Redbreast, for example, while they record the British form as resident in every part of Scotland except Shetland and St Kilda, the Continental variety is reported from only fourteen localities Now, whereas the difference between the two subspecies cannot be detected until specimens are in hand, hundreds of Redbreasts must have been 'collected' to establish a fact not of first-rate importance We do not accuse the authors of a direct share in such slaughter, but their statistics are founded on the result of industry in that line on the part of others, and they inform the reader in the preface that "a great deal of work remains to be done before we have a comprehensive knowledge of the status in Scotland of even our commonest birds "

We note with satisfaction that the authors observe timely reticence by withholding information about certain scarce birds, remarking that "in some instances in the interests of birds themselves it has been necessary to suppress the localities where they breed, for example, the Greenshank in Southern Scotland " It would have been well to observe the same precaution in respect to some other species—the Chough, for example, which formerly used to breed in many parts of Scotland but is now resident in two places only, where it is in imminent danger of extermination owing to the hostility of jackdaws and the baneful industry of collectors

The authors consider it expedient to comply with modern practice in duplicating specific names, and I suppose we must not attribute it to a deficient sense of humour which sanctions the diminutive wren to be heralded as *Troglodytes troglodytes troglodytes*, but surely injustice is done to the great pioneer of classification by adding (L) to these cumbrous titles Linnæus was content to denote the wren as *Motacilla troglodytes*, and assuredly he would have disclaimed having laden the Grey Plover with such cacophonous polysyllables as *Squatarola squatarola squatarola*! Clumsy nomenclature such as this causes the enemy to blaspheme and friends to complain In such cases as it may be desired to duplicate the specific name, this might be conveniently indicated by adding a numeral (2)

The Buffet headed Duck, *Clangula albeola*, is not mentioned in the volume under review, although Yarrell records a solitary instance of its occurrence in Orkney in 1841, and states that the bird was to be preserved in the Natural History Museum at Margate

The foregoing frank criticism must not be interpreted as unfavourable to what is a thorough piece of work, which must have cost the authors no slight labour to compile and will prove very useful for reference HERBERT MAXWELL

Crystal Physics

(1) *Lehrbuch der Kristallphysik (mit Ausschluss der Kristalloptik)* Von Prof Dr Woldemar Voigt Nachdruck der ersten Auflage ergänzt durch eine spätere Arbeit des Verfassers und mit einem Geleitwort von Prof M v Laue (Sammlung von Lehrbüchern auf dem Gebiete der mathematischen Wissenschaften mit Einschluss ihrer Anwendungen, Band 34) Pp xxvi + 978 (Leipzig und Berlin B G Teubner, 1928) 41 gold marks

(2) *The Physics of Crystals* By Dr Abram F Joffé Edited by Prof Leonard B Loeb Pp xi + 198 (New York McGraw Hill Book Co, Inc, London McGraw-Hill Publishing Co, Ltd, 1928) 15s net

(3) *Bibliography of Crystal Structure* By Jared Kirtland Morse Pp xix × 164 (Chicago University of Chicago Press, London Cambridge University Press, 1928) 15s net

IT cannot be too strongly emphasised that crystal physics is no longer a highly specialised branch of physics, dealing with solid matter in what was

formerly thought to be a comparatively rare state The new crystallography has shown, by the study of the interaction of X rays and solids, that the normal stable state of most, and probably all, solid matter is essentially crystalline, that is, there is always a tendency for a group of ions, atoms, or molecules of the same kind to arrange themselves in the solid state in an orderly way Even such substances as stretched rubber and gelatin, and the fibres of our bodies, have given evidence of an orderliness in the arrangement of the units from which they are built This new outlook makes specially welcome the present volumes on crystal physics

(1) Since Voigt's "Lehrbuch der Krystallphysik" has been reprinted by the photomechanical process, it is identical, save for a few additions, with the original edition of 1910 Its outlook is therefore essentially that of classical crystallography The whole field is covered from geometrical and mechanical to electrical properties of crystals There is, unfortunately, no index Naturally, for particular subjects one would look to other sources, such as Love's "Elasticity" or the Geiger and Scheel "Handbuch der Physik," but there is no other book covering the work up to 1910 so well The treatment is mathematical wherever possible, and there is for the research worker too little detail of experimental methods Nevertheless, this reprint is of value, and since the original is so comprehensive and the outlook so classical, it would be much simpler to write an entirely new book than to revise Voigt's monumental work In its present form it gives the research worker a good idea of the many types of research possible in crystal physics

(2) In Joffé's book we have an attractive account of twenty five years' research upon certain problems relating to the elastic and electrical properties An invitation to give a course of lectures in the University of California was used as an opportunity to organise into a consistent whole the results of many researches carried out by Joffé and his collaborators The outlook is fundamentally modern, as can be seen by the opening of the first lecture, where a crystal is defined as a regular arrangement of small units (atoms, ions, or molecules) The electrical theory of crystal lattices is developed, and it is pointed out that no more than the 10^{-15} part of the space is occupied by the electrons and nuclei, the crystal being regarded as an empty space with small charged particles distributed at enormous distances apart

In the first six lectures it is shown how the general predictions of the electrical theory were checked both qualitatively and quantitatively by a diverse series of experimental studies upon the elastic properties of crystals The fascinating account of these experiments admirably conveys the impression of research workers absorbed in their work and ready to adopt any tactics to solve their particular problems For example, no sooner is the X ray Laue method well established than it is applied to the study of the elastic limit (Lecture IV) with results not easily attainable by other methods

The remaining eleven lectures deal with certain electrical properties of crystals in a way that gives the reader the thrill of research well and truly carried out For other research workers there is perhaps too little of that important section of research laboratory, the library In the chapters on the mechanical properties of crystals, one looks in vain for such names as Carpenter, Elam, and Taylor The book must not, therefore, be used as if it were a summary of work so far done in the subjects Its title is misleading, since in the preface it is clearly stated that only a limited portion of the field of the elastic and electrical properties of solids is covered Some of the work discussed would, however, otherwise be available only in Russian The English is sometimes a little difficult, for example, a statement in the preface that "all atoms of a crystal are in the same relative position" is untrue, as it stands The most notable feature of the book is that such interesting and valuable work is presented so as to make the reader feel that he is himself discovering the facts with the research workers in the laboratory

(3) We turn now to the third volume, which is published as the first *Bulletin* of the Crystal Structure Laboratory of the University of Chicago The greater part of this is a bibliography of publications on crystal structure and related topics published between 1912 and 1927 The classification is into sixteen groups according to the year of publication, and the papers of each year are arranged alphabetically under authors The title of each paper is given in English Joint papers are placed under the name of the author whose name appears first on the paper, but there are no cross references A set of reprints of one well known worker was used to test the completeness of the bibliography Four out of eight papers had been omitted, one from the *Phil Mag*, one from the *J Chem Soc*, and two from the *Min Mag*, all well known journals In spite of this the bibliography seems to be very comprehensive, and its use will be very considerably increased when an index is provided in one of the later *Bulletins*

In order to make known ("better known" in the original) the work of the Crystal Structure Laboratory, the bibliography is preceded by an introduction which is largely made up of terminological inexactitudes and is often in questionable taste In one place a programme of investigation of the laboratory is given, consisting of a list of apparently every known type of work in X ray crystallography classified into four sections We are then actually told that "already fundamental contributions have been published in the majority of these sections" We need be in no doubt as to what these fundamental contributions are "The most striking and important contributions of the Crystal Structure Laboratory to date have been in the solution of the structure of these two substances —methane and benzene" The papers giving the solutions are reprinted in the *Bulletin*, and appear to be nothing more or less than interesting speculations They certainly do not justify the statement that 'the structure of the benzene ring has been solved" The crystal structure proposed for ethane is not even hexagonal, and the paper suggests that the author is unaware of this disagreement with crystallographic evidence Moreover, the normal procedure of the X ray crystallographer is to reject a proposed structure if observed and calculated intensities of X ray reflections disagree Mr Morse prefers to suggest that such disagreements between his own proposed structures and the experimental observations of others "may lead to a fundamental revision of our present simple notions concerning the scattering of atoms"

Apparently the only structure work that has been completed in the Laboratory is a determination of the space group of certain sulphates For this purpose the Laue method alone was used Whilst it is true that really able workers, such as Wyckoff, have used this method exclusively with great success, the tendency nowadays is not to rely solely upon one method There appears to be little point in equipping this Laboratory so fully if the full advantages available are neglected

The thought of possible injury to the feelings of Mr Morse and the University of Chicago caused the reviewer to hesitate long before referring thus to the first publication of a newly established Laboratory, but some expression should surely be given of the sense of injury produced in the, comparatively speaking, poverty stricken research workers in pure science in Great Britain when they see part of the world's research funds used in this way while so many problems lack the support needed for their investigation W H GEORGE

Our Bookshelf.

Sheep Production By Levi Jackson Horlacher (McGraw Hill Publications in the Agricultural and Botanical Sciences) Pp x+418 (New York McGraw Hill Book Co, Inc, London McGraw Hill Publishing Co, Ltd, 1927) 20s net

THIS book is partly the result of the impetus which has been given to the sheep industry in the U S A during the last five years, and its consequent repercussion on the enrolments in courses on sheep husbandry in the American agricultural colleges It is written primarily for the sheep producer of America In consequence, its value to the British agriculturist is not excessive To the student of animal ecology, who may desire a rapid survey of the growth and distribution of the sheep industry in the United States, it will be useful The treatment, while not exactly exhaustive, cannot be described as superficial A large amount of information, hitherto only available in *Bulletins* and *Circulars* of the U S Department of Agriculture and in various publications from State experimental stations, has been gathered together under one cover, and made readily available by a satisfactory index

The book is divided into four parts An introductory portion describes the history and development of sheep production, anatomy (briefly), judging, and feeding and digestion General accounts of each are given, which, while adequate for the needs of the agricultural student, are of little use to the advanced worker Part 2 consists of an account of the general principles of sheep breeding, with a description of each of the breeds of American importance Part 3 deals with the establishment and management of a flock, having regard to the suitability of certain breeds and crosses for different localities and markets available Methods of production for mutton and wool are well and clearly stated, and this part will probably be of greatest interest to British readers The concluding part consists of a short glossary of terms connected with sheep and wool

The book is, on the whole, well written, opinions are clearly stated, and logical reasons are offered for most of the conclusions drawn The illustrations, of which there are 137, are either diagrammatic or reproductions from photographs, and are mostly very good, although the American tendency to include landscape views, which either have but little bearing on the subject or mask its outlines, is evident in a number of them The publishers have done their part of the work in their usual satisfactory manner

La chimie d'hier et d'aujourd'hui Par Dr A Kirrmann Pp vii + 148 (Paris Gauthier-Villars et Cie, 1928) 15 francs

THIS is an interesting little book, which may be read with profit by the layman and with pleasure by the enterprising student of chemistry, so far as we are aware, it has no exact counterpart in English It is very successful in affording within a modest

compass a very readable general account of the nature and scope of modern chemistry, of the problems which the chemist has to face, and of his methods of attacking them in the laboratory In tracing the historical development of chemistry, the author rightly insists that "rien ne pouvait ensuite mieux préciser le caractère de cette science que l'étude de son développement historique, de l'évolution des idées directrices et de la description de l'enrichissement progressif des connaissances humaines"

The work contains a short list of technical terms and thumb nail biographies of some fifty celebrated chemists of the eighteenth century and later The *cognoscenti* will appreciate the statements that among the qualifications of the successful research worker are "une imagination active," "une grande habileté manuelle," "une patience sans bornes," and "une érudition suffisante pour éviter de s attaquer à des questions déjà résolues" We commend also to the attention of all optimistic candidates for the Ph D after nine terms' research the closing sentence of this chapter "Le travail de laboratoire peut être terriblement ingrat et le moindre résultat exige une dépense sans compter et de temps et d'efforts" J R

Die Physik, 1914–1926 Siebzehn ausgewählte Kapitel Von Prof O D Chwolson Aus dem Russischen übersetzt von Georg Kluge Pp ix + 696 (Braunschweig Friedr Vieweg und Sohn, A G, 1927) 35 gold marks

This volume is similar in many respects to Prof Andrade's "Structure of the Atom," both in its scope and in the obvious enthusiasm with which it has been written It partakes, however, rather more of the nature of a collection of independent essays, whilst it has a natural bias towards the German and Russian points of view Written as an appendix to Prof Chwolson's general text book of physics, it had its origin in an attempt to summarise for Russian students the work done elsewhere between 1914 and 1922, when the country was isolated, how well it has succeeded may be judged from the fact that it has been translated into French as well as into German

A commendable balance between theory and experiment has been maintained throughout, and there is a satisfactory selection of good figures and of tables of numerical data, whilst each section includes a bibliography Physics has advanced considerably since 1926, but even where much new ground has been broken, Prof Chwolson's accounts of the older researches are stimulating, and should be particularly valuable for physics students starting for the first time on experimental research.

Cambridge Observations Vol 24, Part 2 *Catalogue of Zodiacal Stars for the Equinox 1900 0 from Observations made in the Years 1900–1918* Pp vi + 58 (Cambridge At the University Press, 1928) 5s net

Sir David Gill indicated the importance of accurately surveying all the brighter stars in the zodiacal region, to render them available as comparison stars for the moon and planets Of late years the value of such observations has been further emphasised, since Prof Brown, Dr Spencer Jones, and Dr Innes have all shown that very accurate determinations of the moon's errors can be obtained from observations of the occultations of stars, provided that good positions of the latter are available The Cambridge University Observatory has been engaged since 1900, but with many interruptions, in observing the stars in Sir David Gill's list, and a catalogue containing positions for 1900 0 of 2588 stars out of the 2798 in Gill's list has been published The average number of observations of each star is about five, very few have less than three observations in each co ordinate The observations are not fundamental, but depend on Newcomb's positions of the standard stars Magnitude equation has been applied, it is nearly the same for all the observers, being in the mean 0 01 sec for magnitude 4 5, and increasing fairly uniformly to − 0 08 sec for magnitude 9 0

The Right Ascensions were observed by eye and ear up till 1914, and by chronograph in 1917–1918 Proper motions have not been applied

A C D C

A Text Book of Inorganic Chemistry Edited by Dr J Newton Friend (Griffin's Scientific Text-Books) Vol 6, Part 1 *Nitrogen* By Dr Edmund B R Prideaux and Herbert Lambourne Pp xxviii + 242 (London Charles Griffin and Co, Ltd, 1928) 18s net

A volume on nitrogen provides an exceptional opportunity for a chemist who is alert to the interesting features of his science, since such a volume necessarily includes the foremost technical problem of the day, that of the 'fixation' of nitrogen, as well as some of the most hotly debated questions of molecular structure The latter category covers the problems of variable valency, mixed double bonds and co ordination, and even then leaves the stereochemistry of the element to be dealt with in the light of modern knowledge No higher compliment need be paid to the authors than that they have made adequate use of their opportunities, and have produced a volume which does justice to the fascinating element with which it deals

The Ordinall of Alchimy By Thomas Norton of Bristoll Being a Facsimile Reproduction from Theatrum Chemicum Britannicum, with Annotations by Elias Ashmole With Introduction by Dr E J Holmyard Pp viii + 125 (London Edward Arnold and Co, 1928) 10s 6d net

Dr Holmyard has earned the gratitude of all interested in the history of chemistry by his preparation of this book Norton's poem, although it has no particular value from the point of view of the development of chemistry, gives, if it is authentic, an interesting picture of early alchemy in Great Britain, and since the original is difficult to obtain, this reprint (in facsimile) will appeal to many readers

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications*]

Eddington's Hypothesis and the Electronic Charge

PROF SIEGBAHN has directed my attention to the paper in the *Proceedings of the Royal Society* for January 1929, p 358, in which Prof Eddington arrives at the relation between the electronic charge e and the ratio $hc/2\pi$,

$$\frac{hc}{2\pi e^2} = 136$$

On page 174 of NATURE for Feb 2, 1929, some editorial remarks are made concerning this relation, and it is stated that "*all* existing experimental evidence are in favour of a value very near to 137" Inasmuch as I have carried out an investigation in this field, the results of which were mentioned in Eddington's paper, but which were published only in *Upsala Universitets Årsskrift*, 1928 (Diss , May 1928), I may be permitted to make a few remarks upon the subject

The commonly accepted value of e ($4\ 774 \times 10^{-10}$ E S U $\pm 0\ 1$ %) was determined by Millikan in 1916 There are, so far as I know, no redeterminations of e which claim the same degree of accuracy In the investigation carried out by myself the absolute wave length of the aluminum $K\alpha$ line was determined by means of a ruled, plane reflection grating From this and the known crystal value of the same spectral line, I computed a new value of e, namely, $4\ 793 \times 10^{-10}$ E S U $\pm 0\ 3$ % In a recent paper (*Phys Rev*, Dec 1928), A P R Wadlund, using the same general method (Compton, 1925), gives a value of e ($4\ 774 \times 10^{-10}$ E S U $\pm 0\ 15$ %) which is exactly the same as that found by Millikan

In order to determine the reliability of these three values, each being the mean of comparatively few determinations, it is of importance to analyse in each case the distribution of the individually determined values around their mean For each of his twenty five investigated drops Millikan obtained a value of $e^{2/3}$, and from the distribution of these single values he has computed the 'probable error' to be $\pm 0\ 025$ % From the published $e^{2/3}$ values I have calculated each single e value From their distribution the 'probable error' was found by the usual methods to be $\pm 0\ 04$ %, which agrees with that found by Millikan related to $e^{2/3}$, namely, $3/2 \times 0\ 025 = 0\ 038$ In the diagram (Fig 1) I have plotted the number (Z) of values falling in the intervals 0 0 1 %, 0 1 0 2 %, etc , from the mean The upper curve represents the error distribution for Millikan's determinations The lower figure is the error distribution curve obtained in the same manner from my own single values (29) My mean value is 4 793 and is 0 4 % greater than Millikan's At the bottom of the diagram I have plotted Wadlund's mean value with its published error limits and also its probable error as given in his paper In his paper only one single value of the nine obtained is published, and if this is indicative of his series of measurements, his error distribution must be considerably wider than either Millikan's or my own The position of the e value belonging to this single value departs by 1 % from the mean, and the corresponding probable error is given as $\pm 0\ 18$ % (see Fig 1)

It should be pointed out that the error limits apportioned to each of these three e values are not computed in the same manner In Fig 1, I have indicated by means of horizontal arrows the probable error Δ_p calculated in the usual manner from the formula

$$\Delta_p = \tfrac{2}{3}\sqrt{\frac{\Sigma\Delta^2}{n(n-1)}},$$

where Δ is the deviation from the mean and n the number of values obtained The arithmetical mean error, Δ_m, is given by

$$\Delta_m = \frac{\Sigma\,|\,\Delta\,|}{n}$$

Millikan's published error limits, Δ_a, agree with the value calculated from the relation

$$\Delta_a = \sqrt{\Delta_p{}^2 + \Sigma\Delta_s{}^2},$$

where the Δ_s are the systematic errors estimated

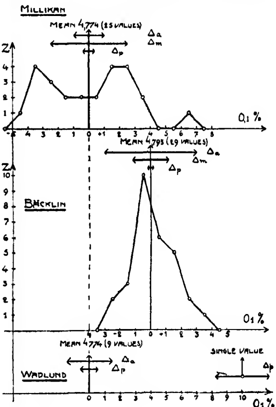

FIG 1

from the method used In my case I have, for the purpose of this calculation, taken

$$\Delta_a = \sqrt{\Delta_m{}^2 + \Sigma\Delta_s{}^2},$$

Δ_m being much greater than Δ_p (see Fig 1) It would require too much space here to explain in detail the error calculations of Wadlund For this I must refer to his paper The diagram is perhaps sufficient

In my opinion it is of more physical significance to carry out such error calculations with the arithmetical mean error Δ_m, than with the so called probable error Δ_p, which is commonly used without the necessary analysis of the error distribution obtained

From the accompanying diagram it is, I believe, clear that from the experimental evidence we can scarcely decide whether 136 or 137 is the better value for Eddington's ratio, especially since h is not known with the same degree of accuracy as e Moreover, it

should be remembered that the value of h is obtained with the aid of a value of e

As to the Rydberg constant R, agreement between the spectroscopic value and that calculated from other physical constants is a criterion not only of the value of e but also of the other physical constants involved (h, e/m)

ERIK BÄCKLIN

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Upsala, Sweden, Feb 15

The Raman and Infra-Red Spectra of Carbon Dioxide

MR RASETTI's examination of the Raman spectrum of carbon dioxide as reported in his letter in NATURE of Feb 9 is of extreme interest He points out (1) a coincidence between (a) the infra red frequencies deduced from the Raman spectrum, namely, 1284 and 1392 cm $^{-1}$, and (b) the wave number difference between the band centres of the double doublet at 2 7 μ and the doublet maxima at 4 25 μ as given by Schaefer and Philipps (*Zeit f Physik*, **36**, 641, 1926), which are 1279 and 1381 cm $^{-1}$, and (2) that there is no known band in the infra red spectrum of carbon dioxide which would correspond with either of these

A further examination of the absorption spectrum mentioned shows that the concordance is far from being a coincidence There is perhaps no physical justification for calculating as Mr Rasetti does, the difference between the maxima in a simple Bjerrum doublet and the band centres in a double doublet Adopting Schaefer and Philipps's nomenclature, we have four double doublets, A, C, F, and K (D and E being uncertain) The assumption of a triangular molecular model with two large and approximately equal moments of inertia, A, and one much smaller, C, gives as a general expression for the double doublet separation,

$$\Delta\nu = \left(\frac{1}{C} - \frac{1}{A}\right)h/2\pi^2$$

(assuming the absence of a zero branch) Now, the average value for this separation in the four bands quoted is 108 cm $^{-1}$, which is 1392 1284 and we should be justified in assuming that the frequencies in question represent such a double doublet

However, the connexion between the deduced values and the observed spectrum is closer still (i) If we determine the wave number differences between the band centres in the double doublets and those in the 'undoubled' bands, we have the values recorded in Table I

TABLE I

Bands	$C \to I$	$K \to B$	$B \to A$
$\Delta\nu$ in cm $^{-1}$	1262 1375	1293 1393	1264 1368

These values are of the same order as the deduced frequencies (ii) If we perform the same operation on the double doublets themselves the agreement is exact, within the experimental error, $F \to A$ giving 1388 and 1282 cm $^{-1}$ (iii) The frequency difference between the undoubled bands is a simple fraction of one of these frequencies, thus $B \to H$ is 687 cm $^{-1}$ (approximately $\frac{1}{2} \times 1392$), and $E \to D$ is 637 cm $^{-1}$ (approximately $\frac{1}{2} \times 1284$) There must consequently be some simple relationship between the double doublet separations and the band centre separations, and we actually find in the two frequencies deduced from the Raman spectrum, that if the former is taken as 107 cm $^{-1}$, we have $1391 = 13 \times 107$, and $1284 = 12 \times 107$

This fact is rendered more prominent by a reconsideration of the emission spectrum as determined by the writer in conjunction with Mr K H Lih (Bailey and Lih, NATURE, **121**, 941, 1928) To account for the regularities in this spectrum, we assumed that the bands could be represented as multiples of a fundamental frequency given by $\nu_0 = 16 \times 10^{11}$, or in wave numbers, 53 5 cm $^{-1}$, *i e* $\frac{1}{2} \times 107$ the half value being adopted to provide for the just perceptible resolution of the band at 2 84 μ Now, if we accept the possible presence of a band at 1284 cm $^{-1}$ (Eucken, *Zeit f Physik*, **37**, 714 (1926), it is interesting to note, postulated the existence of an optically inactive frequency at 7 86 μ, *i e* 1272 cm $^{-1}$) the emission spectrum can be represented in a very simple manner, as will be seen by a consideration of Table II

TABLE II

No	1	2	3	4	5	6	7	8
λ in μ	1 46	1 70	1 99	2 40	2 84	3 12	4 46	(7 80)
ν in cm $^{-1}$ obs	6850	5880	5027	4167	3524	3206	2248	—
ν in cm $^{-1}$ calc	6848	5885	5029	4173	3531	3210	2247	(1284)
n	64	55	47	39	33	30	21	12

The calculated wave numbers are obtained by multiplying $\nu_0 - 107$ cm $^{-1}$ by n, in particular the bands 8, 7, 6, and 4 now become members of a series represented by $3\nu_0(1 + 3m)$ The above results were obtained with a rocksalt prism spectrometer, it is proposed to re examine this spectrum with greater resolution and at higher sensitivity, when possibly other members of the series may be identified It is difficult at the present to see the underlying physical significance of the above results

C R BAILEY

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The Fulcher Bands of Hydrogen

IN a communication just published (in the *Proceedings of the Royal Society of Edinburgh*) I have shown that the Fulcher bands of hydrogen can be arranged in three branches (P', Q, and R'), the Q branches being identical with those of Richardson The P' and R' branches have an initial level differing from that of the Q branch, while all three have a common final level, a fact proved conclusively by the intercombinations found to hold between them This shows the final state to be an S state, as Birge has predicted

It is of interest to inquire how these hydrogen bands fit in with the new mechanics, and in particular to determine the constant σ in the term form

$$B\{j(j+1) - \sigma^2\}$$

An analysis of the bands shows that the terms fit this form provided j is given integral values This is as it should be according to Mulliken's theory, if the emitting molecule is that of neutral H_2 (odd multiplicity) The lowest lines are R' (0), Q (1), and P' (2), which shows that σ'' is zero in the final terms, as we should expect for an S state

While the major part of the term is clearly of the form just given, a preliminary examination of the term differences showed that an appreciable 'correction term' in the fourth power of j (or j_k) is present. Such a term is to be expected on the old theory Unfortunately, no general expansion for the band terms on the new theory is available At the sug-

gestion of Prof H S Allen, the following tentative term-formula was adopted

$$F(j) = \Sigma X_n\{j(j+1) - \sigma^2\}^n, \; n = 1, 2,$$

Here in the usual notation, $X_1 = B$, $X_2 = D$, In using this formula we need only take into account as many terms as are likely to be required Actually, we may obtain a good fit for the hydrogen bands by taking into account only the first two terms ($n = 1$ and 2) Such a two term formula has in fact been found to give a good fit for bands consisting of a large number of members in the case of the blue green bands of Na_2 ($^1P \longrightarrow {}^1S$) described by Loomis and Wood

A least square determination of the constants of the Fulcher null band ${}_2a_0$, taking into account the first four terms of the above formula, yields the following values for the final constants

$$B'' = X_1'' = 33\ 38879 \quad \text{cm}^{-1},$$
$$D'' = X_2'' = -0\ 0229274 \quad \text{cm}^{-1},$$
$$X_3'' = \ 4\ 8565 \times 10^{-5}\ \text{cm}^{-1},$$
$$X_4'' = -3\ 1250 \times 10^{-7}\ \text{cm}^{-1}$$

The initial constants agree in sign and magnitude with the above Moreover, the two values of B' obtained for the initial state one for the Q branch and the other for the P' and R' branches, differ sufficiently to allow the initial constant σ' to be determined within narrow limits Its value comes out as $\frac{1}{4}$, the actual determination being 0 2506 This result is curious, and points to some, as yet unexplained, peculiarity of the term form

With this value of σ' we obtain

$$B_A' = 29\ 60537 \text{ cm}^{-1} \text{ for the } Q \text{ series}$$
$$\text{and } B_B' = 29\ 84408 \text{ cm}^{-1} \text{ for the } P' \text{ and } R' \text{ series}$$

It may be pointed out that in the case of the $^1P \longrightarrow {}^1S$ bands of Na_2 these constants only differ by 0 00001 cm $^{-1}$ Thus, hydrogen seems to present possibilities for band analysis which are lacking for the heavier molecules

It is hoped to discuss the Fulcher bands in greater detail in a future communication

Ian Sandeman

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Feb 1

The Angular Distribution of Compton Recoil Electrons

Up to the present the 'intensity problem' of the Compton theory has remained unsolved Many hypotheses have been put forward, and there exist two different solutions based on the new quantum mechanics, experiment, however, has not given any definite decision in favour of either solution

There are two ways of experimental test the investigation of the angular distribution of the secondary quanta (scattered radiation), or the study of secondary recoil electrons In both cases the decisive information may be obtained only by using very hard rays, that is, γ rays Wilson's cloud expansion method presents essential advantages in this respect The spectral distribution of the secondary β rays emitted under the recoil angles $\delta < 20°$ is known from my measurements published in 1927 (*Zeit f Phys*, B **43**, 354) More detailed data were reported at the conference on β and γ ray problems (Cambridge, July 1928) These data enable one to determine the corresponding statistical weights of the different spectral components of the inhomogeneous radiation used for each given distribution examined The results of this comparison are thus independent of the supposed distribution of intensities in the primary spectrum, this supposition in most cases being based on very untrustworthy data taken from an outside series of observations

In the following table the angular distribution of a thousand β ray tracks measured in the course of the last one and a half years (observed in the gas under the action of a narrow beam of γ rays filtered through 3 5 mm of lead) is compared with the results of calculation according to three different theoretical formulæ In each individual case the recoil angle has been determined with sufficient accuracy by measuring Wilson's photographs on Pulfrich's stereo comparator The figures enclosed in brackets in the column of observed values correspond to three separate series of measurements, including 408, 298, and 305 tracks each The figures belonging to the first series are reduced in the proportion of 300 408 The comparison with the data supplied by the latest theories of Dirac–Gordon and Klein–Nishina is also shown in a diagram (Fig 1) The areas limited by separate parts of the broken lines are proportional to the calculated number of electrons in the corresponding intervals, the circles giving the observed values of the mean ordinates for the same intervals

Numbers of recoil electrons in different angular intervals

	Observed		Calculated according to					
			Klein Nishina		Compton		Dirac Gordon	
		n_0	n	$\frac{\lvert n_1 - n_0\rvert}{n_1}$	n_2	$\frac{\lvert n_2 - n_0\rvert}{n_2}$	n_3	$\frac{\lvert n_3 - n_0\rvert}{n_3}$
0°–10°	39, 34, 44	117	92	0 27	72	0 62	48	1 44
10°–20°	48, 54, 47	149	152	0 02	148	0 01	93	0 60
20°–40°	76, 81, 85	242	266	0 09	264	0 08	280	0 14
40°–60°	75, 66, 74	215	224	0 04	230	0 07	287	0 25
60°–80°	56, 55, 50	161	146	0 10	162	0 01	171	0 06
80°–90°	6, 8, 5	19	20	0 05	26	0 27	22	0 14
			$\frac{\overline{\lvert n_1 - n_0\rvert}}{n} = 0\ 095$		$\frac{\overline{\lvert n_2 - n_0\rvert}}{n_2} = 0\ 177$		$\frac{\overline{\lvert n_3 - n_0\rvert}}{n_3} = 0\ 44$	

Klein and Nishina's letter (Nature, **122**, 398, 1928) contained a comparison of the intensity curves of scattered radiation calculated on the three theories mentioned above In this case the curves differ considerably only in the region of large scattering angles, where the intensities of the scattered rays are extremely weak, therefore any definite decision in favour of either curve is scarcely to be expected. The observed angular distribution of the secondary electrons, however, diverges from Dirac–Gordon's curve to a large degree and is definitely in contradiction to their theory

Of all the three theoretical results compared above, Klein–Nishina's formula is in the best agreement with our data The discrepancies, however, exceed even in this case the probable statistical deviations These discrepancies also cannot be attributed to experimental errors only We are evidently confronted with systematic deviations, which will be shown more clearly in a detailed paper shortly to be published

The question of the angular distribution of secondary radiation is intimately connected with the problem of the determination of the scattering absorption coefficient as a function of wave length This relation is implicitly contained in the formulæ of Dirac–Gordon and Klein–Nishina, which determine the above distribution

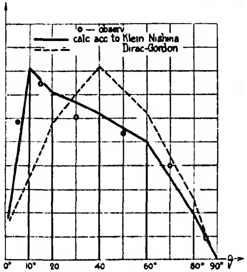

FIG 1 —Distribution of recoil electrons

The result of the comparison quoted above can be therefore considered as a serious argument against the scattering absorption formulæ deduced by Dirac and Gordon, as well as against the estimations of the wave length of ultra γ rays based on this deduction

D SKOBELTZYN

The Physical Technical and
Polytechnical Institutes,
Leningrad, Jan 22

The Complexity of the K-β Line of X-ray Spectra

RECENT measurements of the X ray spectrum line $K\beta'$, and the separation of this line from the $K\beta_1$ line, make it remarkable that their separation had not been attained in the course of earlier measurements (M Siegbahn, V Dolejšek, *Zeit f Phys*, **10**, 159, 1922), especially in the case of elements of low atomic number, where the difference between $K\beta'$ and $K\beta_1$ is about 6 X U.

N Seljakov and A Krasnikov (*Zeit f Phys*, **33**, 601, 1925 NATURE, **117**, 554, 1926) distinguished the line $K\beta'$ for the element of atomic number 25 (manganese), and G Ortner (*Akad d Wiss Wien*, 1926 NATURE, **117**, 823, 1926) separated it in the case of some compounds of iron and cobalt These investigations show that only with certain compounds are these lines distinguished, and this has suggested to us that, in the case of lower elements, the diffusion of this line is dependent upon the state of chemical combination

We have now examined different manganese compounds with the object of determining this dependence, if possible, but within the limits of precision no relationship between the state of chemical combination and the breadth (diffusion) or displacement of the line has been found, and in all cases the $K\beta'$ line is readily distinguished (Fig 1)

The microphotometric curves of the lines from different compounds make it apparent that the ratio of the lines $K\beta_1$ $K\beta'$ becomes greater for oxides than for free elements, in which case it coincides with the results of Seljakov and Krasnikov The value of this ratio, in the investigations of Seljakov and Krasnikov, is found to be 2 1 The determination of the value of the intensity ratio from our measurements is not considered here, this is being investigated independently with J Hrdlička, and the results will be presented in due course

Although we could not ascertain, within the limits of our measurements, any influence of the chemical combination on the displacement of the lines, we

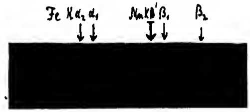

FIG 1

cannot say that it does not exist Such quite small influence could manifest itself with the compounds—which are not stable on the anticathode—by the diffusion (broadening) of the lines To eliminate such possible source of error, we used only the free metals for our measurements of the $K\beta'$ line of other elements

The measured differences of this line from the $K\beta_1$ line are shown in Fig 2

The curves (a, a) in this Fig show also the different breadth of this line $K\beta'$ in the case of different elements For the lower elements the breadth is greater —twice greater—than that of the $K\beta_1$ line With these elements we have found that the $K\beta'$ line is two

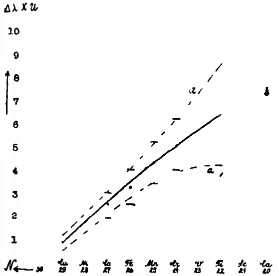

FIG 2.

unresolved doublet lines, which in the case of the higher elements are superimposed As is well known, the difference Δλ between the $K\beta'$ and K-β_1 increases with the decreasing atomic number As one can see from Fig 2, the breadth of the line increases simultaneously with the decreasing atomic number That is the reason why it is so difficult to distinguish $K\beta'$ with elements of lower atomic number (Δλ = c 6 X U) as compared with those of higher elements (Δλ = c 2 X U)

We have measured, separating this line in all the

elements mentioned, the difference $\Delta\lambda$ from the middle of the lines contrary to our previous measurements of the edges of the emission bands Therefore we can determine quite surely the energy frequency difference $\Delta\nu/R$ of the $K\ \beta_1$ and $K\ \beta'$ This difference of frequency resulting from our measurements $\Delta\lambda$ does not coincide with the values calculated from the frequency differ ences of the M_{II} and M_{III} levels, and consequently these two lines cannot both be due to transition $K \longrightarrow M_{II}$, $K \longrightarrow M_{III}$, in agreement with the opinion of G Ortner (*l c*) and D Coster and M F Druyvesteyn, (*Zeit f Phys*, **40**, 735, 1927)

Further, from our measurements we can see, by following the course of the $\Delta\lambda$ of these lines, their dependence on the atomic number (Fig 2), that there is no peculiar change in the region of the iron family

In conclusion, we consider that the $K\ \beta'$ is a complex line, and it is impossible to arrange the line in the scheme of Bohr and Coster The origin of this line is as yet unknown

V DOLEJŠEK
H FILČÁKOVÁ

Physico Chemical Institute,
Charles' University,
Prague, Jan 9

Diœcism in *Ranunculus acris*

DURING the course of a cytological investigation of the reproductive organs of diœcious and intergrade forms of *Ranunculus acris* L, in connexion with the genetical work of Mr F M Marsden Jones and Dr W B Turrill, a matter of some general interest has arisen, which it is thought advisable to put on record forthwith

Examination of a hermaphrodite flower showed that there are two distinct and successive phases in the development of the flower first, a male or anther phase, marked by the commencement of physiological activity in the tapetum, and continuing until the formation of mature pollen grains, and secondly a female or ovule phase, commencing with the growth of the ovules and continuing until the formation of mature embryo sacs This development of male and female tissues in successive phases is the normal arrangement in hermaphrodite flowers, the interval between the two reduction divisions being constant for any given species, the variations between different species being correlated with the amount of ovular development therein

In the flowers of a 'female' plant of *R acris* the male and female phases coincide completely, the reduction divisions in anthers and ovules commencing at the same time The two processes are not able, apparently, to proceed concurrently, and complete failure of the tapetum in the anthers is probably due to lack of sufficient food supplies reaching them from the main axis

Several of the forms of *R acris* intermediate between 'normal hermaphrodite' and 'female' were also examined, and there was found to be a direct correlation between the extent of overlap of male and female phases on one hand, and the amount of good pollen produced on the other In each case the commencement of growth in the ovules was associated with the sudden failure of the tapetum in the anthers of the same flower, with cessation of pollen develop ment as a sequel

It is conceivable that this time factor will explain the occurrence of complete and partial diœcism in many species, in those plants where all grades from staminate to pistillate flowers are found, there are indications that the appearance of partial or complete 'male' forms, with a corresponding sterility of the ovules, may be explained by variations in the vascular structure of the flowers under consideration

A detailed account of the influence of this time factor in *R acris* and some other species is being prepared for publication

R O WHYTE

Botany School,
Cambridge

Floating Mercury on Water

WHILE trying, recently, a process for cleaning mercury, I obtained some small globules floating on water, in the same way that a waxed needle floats The mercury had been shaken with sulphuric and chromic acids, and was finely subdivided, on pouring carefully into water, a few globules floated Some of these ran together and coalesced in deep depressions in the surface the largest floating globule was about 0 5 millimetre diameter The flotation was quite

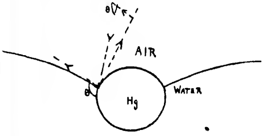

FIG 1

stable and was not destroyed even by contaminating the surface with a drop of oleic acid, which spreads to a film reducing the surface tension to about 46 dynes per centimetre The accompanying rough sketch (Fig 1) shows the directions of the relevant surface tensions dotted in

The tensions of clean mercury against air (475 dynes per centimetre) and against water (375) differ by more than the surface tension of clean water, so that it would be impossible for clean mercury to float on water, the water would spread over the whole drop with zero contact angle It is, however well known not to be easy to get mercury clean enough for water to spread on it The condition of flotation is that the contact angle θ, should be definite and for stable flotation it should be large The mercury air tension must be reduced to well within 46 dynes per centi metre of the mercury water tension, for flotation on the surface contaminated by oleic acid Since the mercury had been emulsified in the mixed acids probably even the mercury water tension had been a good deal reduced, therefore the mercury air tension seems to have been reduced by an amount of the order one or two hundred dynes per centimetre

I have never seen a description of the floating of mercury, and should be interested to hear if there is any record of it, or if anyone else has observed it

N K ADAM

The University,
Sheffield, Feb 12

The Electric Moment of Primary Alcohols

OF late the question of the permanent dipole moment of polyatomic molecules has been considered of great importance in order to elucidate the nature of forces that interact between the constituent atoms of the molecules

The electric moments of a number of primary and secondary alcohols have been determined in this

laboratory by Mr P C Mahanti and Mr R N Das Gupta with the Nernst bridge method, and the results clearly indicate that, so far as the *primary* alcohols are concerned, they have practically the same dipole moment in them

Substance	Chemical Formula	$\mu \times 10^{18}$	Observers
1 Methyl alcohol	CH_3OH	1 64 1 61	F W [1] J [2]
2 Ethyl ,,	C_2H_5OH	1 64 1 63	F W W [3]
3 Propyl ,,	C_3H_7OH	1 66	F W
4 Butyl	C_4H_9OH	1 65 1 62	L [4] M D [5]
5 Hexyl ,,	$C_6H_{13}OH$	1 64	
6 Octyl ,,	$C_8H_{17}OH$	1 62	,,
7 Noxyl	$C_9H_{19}OH$	1 60	,,
8 Decyl ,,	$C_{10}H_{21}OH$	1 63	
9 Duo-Decyl ,,	$C_{12}H_{25}OH$	1 62	
10 Benzyl ,,	C_7H_7OH	1 66	W
11 Iso propyl alcohol	$CH_3CH(OH)CH_3$	1 78	M D
12 Iso Butyl ,,	$(CH_3)_2CH\ CH_2(OH)$	1 79 1 72	,, L
13 Iso-Amyl ,,	$(CH_3)_2CH\ CH_2CH_2OH$	1 82 ? 1 76 1 85 ?	M D L W

[1] F W Falckenberg and H Weigt
[2] J M Jona
[3] W J W Williams
[4] L Luise Lange
[5] M D P C Mahanti and R N Das Gupta

Since these alcohols are produced by the substitution of one atom of hydrogen by an OH group in the normal hydrocarbon molecules, it is reasonable to infer that the dipole moment is due to the polarisation of the oxygen atom by the hydrogen atom on one hand and by the carbon atom on the other In other words, it may be stated that the binding forces acting on the carbon atom reacting with the oxygen are just the same whether the chain is long or short, open or closed It may also be pointed out that the carbon atoms associated with the CH group forming the iso alcohols have quite different binding forces leading to different values of the permanent dipole moments The details of the investigation will be published elsewhere

P N GHOSH

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92 Upper Circular Road, Calcutta

Action between Copper Salts and Glycerol

A VIGOROUS action occurs when a solution of any of the copper salts (hydrated or dehydrated) in glycerol is heated to about 150° to 200° C

The salts, with the exception of cupric chloride, are invariably decomposed into metallic copper (fine powder more than 99 per cent pure) and free acid, which may also undergo further decomposition The decomposition products of glycerol are ethyl alcohol, acrolein (when the salt acts as a dehydrating agent), carbon dioxide, methane, carbon monoxide, and hydrogen, the last two being present only in small quantities

With cupric chloride instead of metallic copper a white precipitate of crystalline cuprous chloride is obtained This may be regarded as due to a secondary action set up in presence of copper, hydrochloric acid, and cupric chloride which is still in solution The action seems to be fairly general, as other polyhydroxy alcohols (glycol, erythritol, and mannitol) give nearly the same result

It is known (Sabatier and Gaudion, *Compt rend*, **166**, 1033 1039, 1918) that glycerol vapour is decomposed into almost the same products mentioned above, at 330° C, in presence of finely divided copper It is very likely, therefore, that in the present case a proportion at least of the decomposition products are due to the catalytic action of copper

If, as is generally believed, metallic salts dissolve in polyhydroxy compounds, replacing the hydrogen of the hydroxyl group by the metal, copper and glycerol would form a compound of the formula: $C_6H_{10}O_6Cu_3$ Further, as copper, carbon dioxide, and methane are the chief products of the reaction a possible way of explaining it would be: $C_6H_{10}O_6Cu_3 = 3Cu + 3CO_2 + CH_4 + C_2H_6$, although there is no direct evidence of ethane

Apart from the theoretical considerations the reaction gives a method for preparing pure, finely divided copper, which is very suitable for catalytic purposes Even crude copper sulphate yields quite a good product The method may be also employed for preparing cuprous chloride from cupric chloride, the reduction being quantitative

A detailed paper on the subject will be published shortly

B K VAIDYA

The University, Liverpool

Effect of Electric and Magnetic Fields on the Helium Spectrum

(BY IMPERIAL WIRELESS SERVICES)

WITH a nearly uniform magnetic field of fifteen thousand gauss perpendicular to an electric field which varies from zero to fifteen thousand volts per centimetre, I find many lines which are not ordinary Stark components and appear not to be due to impurities Effects are similar in the corresponding parhelium and orthohelium line groups near the diffuse series lines For example, strong lines appear on the violet side of 4388 A and 4026 A at distances nearly double those of the usual fundamental combination lines of the Stark effect These well defined lines show no decided polarisation, and at maximum field are displaced toward the red 0 5 A and 0 2 A respectively At an intermediate value of electric field, components in 4026 group are displaced from the diffuse line 0 25 A, 0 47 A, 0 62 A, 0 78 A, 1 90 A, 2 10 A The components in positions of usual Stark components of large displacements are relatively diffuse

That new lines should appear in the presence of crossed fields was first stated by Prof Bohr It is now possible to make repeated observations on these, owing to experimental features which will be described in a later paper

In this research, I have been assisted by Dr Chalk through a grant from the National Research Council of Canada

J S FOSTER.

McGill University,
Montreal, Mar 10

Band Spectrum of Chlorine or Hydrogen Chloride

FURTHER investigation of the bands described by me in NATURE of Jan 19, p 86, leaves no doubt that these were caused by traces of sulphur introduced into the stream of hydrogen by the sulphuric acid wash bottle They are very similar to the bands described by Johansen (*Zeit wiss Photographie*, **11**, 20, 1913)

E B LUDLAM

University Chemical Laboratory,
Edinburgh, Mar 1

The Transvaal Fossil Human Skeleton

By Dr ROBERT BROOM, F R S

AT the end of January last a road party, working in the Springbok Flats about eighty miles north of Pretoria, in excavating calcareous ground to make a road, came across a human skeleton and bones of the extinct buffalo (*Bubalus Bainii*) and of a large antelope The spot where the bones were found has been visited by Mr C J Swierstra of the Transvaal Museum and Mr Herbert Lang, and they have taken careful observations of the occurrence There is a foot and a half of dark reddish-brown surface soil, with below it about six feet of calcareous tufa (Fig 1) The skeleton was obtained at a depth of three feet from the surface and thus about one and a half feet from the top of the tufa The bones are for the most part much impregnated with lime and, except the powerful long bones, badly broken The skull is mostly broken into pieces about the size of half a crown or smaller, but fortunately the mandible is well preserved In the opinion of Mr Lang, the man has probably been killed while hunting and his body crushed in the mud by the trampling of a wounded buffalo—not improbably the one whose bones lay near his own Mr Swierstra has kindly asked me to make an examination and report on these bones

FIG 1 —The quarry where the human remains were found Mr Miller who discovered the remains, is pointing to the layer in the tufa where the bones were found

The fitting together of the cranial fragments has been a matter of some difficulty, as at present about a quarter of the fragments are missing, and most are so impregnated with lime that it is difficult getting them sufficiently cleaned to fit nicely Still, enough has been done to give a satisfactory idea of the shape and general character of the skull

The Transvaal Museum is at present at work going over all the ground to endeavour to obtain all the missing fragments As this will take a considerable time and will not alter materially any conclusion that can now be come to with regard to the skull, there seems nothing to be gained by delaying, more especially as the press has been largely interested in the matter and has been issuing reports, some of which are not altogether correct

At present we have almost the complete right side of the skull and much of the left side, but without the basicranial region, and the whole of the face except the frontals and malars is lost The mandible is practically complete Of the post cranial skeleton there are remains of three vertebræ and fragments of many ribs, a fragment of one scapula, half of one clavicle, both humeri but with the ends lost, much of both radii and ulnæ, and much of one hand There is no trace of the pelvis or sacrum, but both femora are well preserved except that the ends are lost, and there is much of both tibiæ and parts of the fibulæ, with a well preserved astragalus

The skull is of the modern type with a fairly large brain The maximum length is about 195 mm and the breadth is about 144 mm The antero posterior measurement can be relied on as very nearly accurate, but the breadth is less certain, as the fragments of the left side of the skull cannot at present be fitted together, but the greater part of the occiput and frontales are preserved, and the middle line can thus be approximated The cephalic index is thus about 74 The frontal region slopes, as seen on the photograph (Fig 2), and is not in the least Neanderthaloid The frontal bone is narrow, the width at the lower part being about 106 mm The parietal region is lower than in most modern types of man, and there are no marked parietal eminences The bones are not unduly thick—the maximum being less than 9 mm

The mandible is unusually long and very massive, and there is a well marked chin (Fig 3) The ascending ramus is very wide, being 48 5 mm from the front of the coronoid process to the hollow below the condyle From the condyle to the front of the symphysis is about 141 mm The symphysis is 17 5 mm in thickness The teeth are

relatively small, the three molars measuring only 30 mm and the molars and premolars together 42 mm The crowns are badly worn down, and the pattern cannot with certainty be determined There seems, however, to be no clear evidence of a 5th cusp, except perhaps in *m* The under side of the symphysis resembles considerably that of Neanderthal man The angle of the jaw is extremely thick (7 8 5 mm) and has prominent muscular ridges

The limb bones are large and powerful I estimate the humerus to be about 330 mm long, but as both ends are lost it is impossible to give the measurements quite accurately The radius ulna and phalanges are all those of a powerfully built man

The femur can be restored with much probability only the head and the distal end being unknown There is considerable resemblance to the thigh bone associated with the Rhodesia skull The bone is very long and massive the greatest length is as near as may be 500 mm The shaft measures below the lesser trochanter 36 mm by 28 mm The shaft is very considerably curved The tibia is about 435 mm in length and the shaft near the nutrient foramen measures 40 mm by 30 mm

A comparison with previously known prehistoric human skulls at once suggests a possible affinity with that of Cro Magnon man and with the previously known large brained South African fossil type the Boskop man The present skull which may be referred to as the Bushveld skull resembles both in being large brained and in having a fairly good forehead and quite small supraorbital ridges The man was also like that of Cro Magnon,

Fig 2 —Skull of Bushveld man as restored by R Broom

of large stature But there are some points of striking difference Cro Magnon man had a high parietal region Bushveld man has, like the Hottentots and Bushmen a relatively low parietal region This is a point to which most anthropologists pay little attention, but it is in my opinion one of very great importance Lowness of the parietal region is evidently a primitive character It is found in *Pithecanthropus*, *Eoanthropus*, Neanderthal man, Rhodesian man, and in Boskop man and in the Bushman of to day In Cro Magnon man, as in most living races, the parietal region is high There are many other striking points of difference, though possibly Cro magnon man may be descended from a Bushveld like type

Boskop man also has some points of likeness Both have low parietal regions, but there are few

Fig 3 —Under side of jaw of Bushveld man with jaws of a Kaffir and a Hottentot for comparison

other resemblances Boskop man has prominent parietal eminences Bushveld man has not Boskop man has parietals 15 mm in thickness The skull of the Bushveld man is nowhere more than 9 mm The teeth of Boskop man have apparently been large those of Bushveld man are small The bones of the Boskop man are much more completely mineralised and probably older but until a good skull is obtained it will be impossible with certainty to fix its position

The Bushveld man was certainly the contemporary of the extinct *Bubalus Bainii* At Hagenstad, in the Orange Free State, we have many human implements in association with the bones of not only *B Bainii* but also of the extinct *Equus capensis* and of two large extinct antelopes We are thus probably justified in assuming that the Bushveld man was a member of the race that made the Hagenstad type of implements These implements according to the archæologists, are regarded as representative of the middle old stone age of South Africa and we may thus regard the Bushveld man as the man of the middle Palæolithic period Of course, at present we are quite unable to date the remains in years We can only say that they are certainly very old

There are many reasons for regarding the Korannas a few of whom still survive in South Africa, as the direct descendants of the Bushveld type of man For many years I have regarded the Korannas as one of the most important of the surviving races, though hitherto anthropologists have given them very little consideration From the enormous numbers of implements found in the diamond gravels there must have been a powerful race numbering tens if not hundreds of thousands, inhabiting the Vaal River valley in prehistoric times This Bushveld skeleton is the first evidence we have of a man that probably belonged to this race, and it is interesting to find how closely he agrees in many respects with the surviving Korannas of to day

Chemiluminescence [1]

By Dr ERIC K RIDEAL

IN attempting to make the subject matter of this discourse as experimental as possible, it will be impossible to delve in great detail into the molecular mechanism of the reactions This, I think, is as well, because many of the reactions which should be shown on account of their great beauty are certainly extremely complicated and have not, in fact, been subjected to any but a very superficial examination

Chemiluminescence may be regarded as the counterpart of photochemical processes By the absorption of light of suitable frequencies atoms and molecules may be raised to states of higher initial energy These excited entities may now undergo a series of changes, the nature of which will depend on a variety of circumstances They may liberate their absorbed energy in the form of fluorescent light, impart part or all of their energy to a neighbour of another species by a collision, become converted into a metastable more permanent and energy rich molecule which may afterward revert to the normal form, or suffer some species of chemical reaction such as ionisation dissociation, or combination

By suitable modification of conditions one can affect the velocities of chemical reactions over relatively wide ranges, and it is found that in many strongly exothermic reactions there exists a narrow range of relatively high velocities which is chemiluminescent Closer examination indicates that practically all these reactions are complex in that they are accompanied not only by the emission of radiation localised in some portion of the spectrum but also by a rise in temperature It is by a study of the chemiluminescent portion of such composite reactions that we may hope to gain a further insight into the molecular mechanism and the operation of the process of chemical activation

We may with some degree of assurance assume that chemiluminescence is in many cases the result of liberation of chemical energy in a form similar to that of fluorescent energy, and we have noted that fluorescence is the result of decay of a number of excited molecules, the excitation being produced in this case by the absorption of radiation Thus conditions suitable for chemiluminescence result in reactions in which large numbers of excited molecules are produced by chemical reaction, under conditions such that at least a fraction of the excited molecules can revert to the normal form with the emission of radiation Excluding thermally accelerated exothermic reactions, a large group of auto accelerating reactions exhibit chemiluminescence, these are usually designated as branching chain reactions, and we shall observe that there are several hypotheses as to the nature of such reactions and at least two distinct light-producing processes

A typical reaction of this type is the oxidation of phosphorus—one of the oldest chemiluminescent reactions observed with a definite substance, although the chemiluminescence of fireflies, decaying wood and certain bacteria and fish have long been commented on and were formerly attributed to the action of vital forces The name phosphorus arose from a confusion of chemiluminescence with the phosphorescence of the impure barium sulphide, the so called lapis Bologniensis We may symbolise the fact that the reactions proceed in branching chains in a number of ways thus, denoting the reactants by A_2 and B_2 and the molecules in the excited state by A_2, we might postulate as the mechanism

$$
\begin{aligned}
(a)\quad & A_2 + B_2 \longrightarrow A_2B_2 \longrightarrow (AB)_2 \longrightarrow AB + AB \\
& AB + A_2 \longrightarrow AB + A_2 \\
(b)\quad & A_2 + B_2 \longrightarrow AB + A + B \\
& A + B_2 \longrightarrow AB + B \\
& B + A_2 \longrightarrow AB + A
\end{aligned}
$$

In both cases the conditions that one elementary reaction shall produce at least two reacting molecules so as to effect an auto accelerated reaction are fulfilled, but whilst in the first the chemiluminescence is imagined to result from the return of the excited species AB or A_2 to the normal in the second it is supposed to take place through some type of atomic combination, for example $2A \longrightarrow A_2$ or $A + B \longrightarrow AB$, a mechanism which has been more fully investigated in a series of reactions which will be discussed later

We may note that in addition to these types of chain mechanism there exists a third in which it is imagined that a certain number of reaction centres are formed by some identified as ions, around these reaction centres reaction takes place and more reaction centres are formed As a hypothetical case we might imagine that in a hydrogen chlorine mixture a positive ion is formed and around this ion a number of hydrogen and chlorine molecules are held by electrostatic forces On neutralisation of the ion the energy set free effects the combination of the small group of molecules around the ion and chemiluminescence and the formation of a few more ions result

That in the oxidation of phosphorus, sulphur, and probably many other substances the chemiluminescence is the result of some such type of chain mechanism can scarcely be doubted, but it is difficult in fact to state to which of these three possible types any one reaction definitely belongs It is perhaps significant that in the oxidation of phosphorus a number of the lines in the complex band spectrum of the emitted light are identical with those of ionised oxygen A typical phenomenon observable in the chain or cluster reactions is that of inhibition by small quantities of inhibitors We may note the ease with which inhibitors such as benzene and ether inhibit the glow of phosphorus, a confirmation of the nature of the chemical process at work Many other vapours exhibit chemiluminescence on oxidation, a fact noted by Sir Humphry Davy, thus the vapours of ether and carbon disulphide can readily be caused to undergo cold luminous combustion Under more restricted

[1] From a lecture with experiments, delivered at the Royal Institution on Friday, Feb 15

conditions, the union of acetylene and chlorine and the oxidation of the hydrocarbons can be made to exhibit chemiluminescence, and although in these reactions the thermal changes are relatively large, yet since the light emitted is definitely chemiluminescent it seems almost certain that, contrary to the views of several investigators in these reactions, one cannot be dealing exclusively with thermally accelerated as opposed to branching chain or cluster accelerated reactions, excited molecules atoms, or reactive clusters must be taking part in the reaction

Far more complicated, but equally beautiful, are a number of chemiluminescent reactions taking place in solution The well known Wedekind reaction, the interaction of chlorpicrin and phenyl magnesium iodide exhibiting a green chemiluminescence, requires the use of a draught chamber, but the cold oxidation of pyrogallol formaldehyde mixture exhibiting an orange red light, due to Trautz and Schorigin, blue luminescence in the oxidation of 3 aminophthalic hydrazide and the green of tri phenyl glyoxalin (Lophin) are all brilliant and readily demonstrated These reactions are characterised by a high temperature coefficient—some 2 3 for a rise of 10° C —an indication of the chemical origin of the light emitting system

It is somewhat remarkable that few people have observed the beautiful chemiluminescence exhibited by the interaction of chlorine or chromyl chloride with ammonia, although I suppose the former reaction is demonstrated annually in at least one of the classes in every school where chemistry is taught

Sir James Dewar noted a chemiluminescence when ozone is brought into contact with organic matter Such chemiluminescence is particularly marked in the oxidation of certain dyestuffs both fluorescent and non fluorescent, we may observe the phenomenon in a brilliant form in the case of alcoholic solution of both eosin and safranin The chemiluminescent light is not identical with the fluorescent light of these dyes This reaction may be modified so as to give a very vivid demonstration of the action of inhibitors By addition of a small quantity of hydroquinine to the alcoholic solution of safranin we note that on exposure to ozone no chemiluminescence results, the dyestuff is not oxidised, but after a minute or two the hydroquinine is completely oxidised and the brilliant green glow of the dyestuff undergoing oxidation spreads over the bulb

We have already indicated the possible connexion between chemiluminescence and reversed photochemical action, postulating in both cases the generation of an excited molecule formed in the former by chemical and in the latter by radiant processes This analogy may be pursued somewhat further by a consideration of the mechanism of photochemical sensitisation and its reversal In cases of photochemical sensitisation, a molecule excited by the absorption of radiation conveys by collision part or all of its energy to a molecule of another species which afterwards undergoes chemical reaction The beautiful experiments of Franck and Cario in forming chemically reactive hydrogen by sensitisation with mercury vapour excited by the line $\lambda 2537 \cdot 4$ A may be cited as a case of photochemical sensitisation A similar complementary reaction in chemiluminescence has been observed by Kautsky, who showed that the energy liberated as chemiluminescence in the oxidation of the suboxide of silicon, siloxene, could be transferred to certain dyestuffs causing them to become excited and undergoing fluorescence Only those dyestuffs such as fluorescein and eosine which are adsorbed by the crystals of the siloxene can be made to fluoresce, an indication that the energy necessary for excitation of the dyestuff molecule must be transmitted by collision from one of the surface molecules of the solid reacting siloxene, which in turn must pass through the stage of an excited molecule during oxidation

The experiments initiated by Haber and Zisch on the interaction of the alkali metals with halogens and halides have more recently been re examined by numerous investigators, notably Kondratjew, Ljalikoff, and Polanyi, these all exhibit beautiful chemiluminescent effects The interaction of sodium and iodine vapour and of potassium and iodine demonstrate the various phenomena to be observed in these reactions, and analysis of the radiation, as well as of the distribution on the tube walls of the salt formed, gives us a clue to the mechanism of the reaction In the interaction of sodium vapour and iodine we may compute the thermal changes accompanying all the possible reactions

$$
\begin{aligned}
&(1)\ Na + I_2 = NaI + I + 33 \cdot 5\\
&(2)\ Na + I = NaI + 68 \cdot 7\\
&(3)\ Na_2 + I = NaI + Na + 51\\
&(4)\ I + I = I_2 + 35 \cdot 2
\end{aligned}
$$

It is observed that the D line only is emitted, corresponding to a chemiluminescent emission of 48 3 cal Of the four reactions listed above, only two are accompanied with sufficient energy for the liberation of the D line, namely, (2) and (3) A further observation that the chemiluminescence possesses in this case a negative temperature coefficient, suggests that only one of these reactions, namely, $Na_2 + I = NaI + Na$, is responsible for the chemiluminescence observed in the gas phase, and that neither (2) nor (4) takes place in the gas phase except in a reaction more involved than a bimolecular one The tube walls catalyse both reactions (2) and (4) effectively The surface catalysed reaction is clearly observed in the union of potassium and iodine, for the reaction (3) above does not occur to an appreciable extent when sodium is replaced by potassium on account of the low concentration of diatomic potassium molecules in the vapour of the element

The bulk chemiluminescent processes can accordingly be represented as

$$
\begin{aligned}
&Na_2 + I \rightarrow NaI' + Na\\
&NaI' + Na \rightarrow Na' + NaI\\
&Na' \rightarrow Na + h\nu
\end{aligned}
$$

Chemiluminescent methods may be employed not only to identify as noted above the nature of

the molecular processes involved in a chemical reaction, but also to fix, within certain limits at least, the energy of dissociation of certain gases Thus, the simple dissociation process,

$$H_2 \rightleftarrows 2H,$$

in reality must be much more complicated in operation than the unimolecular bimolecular dynamic equilibrium postulated by this equation given in the text books Whilst the efficiency of collision in causing reaction of complex molecules such as $2NO_2 \rightleftarrows N_2O_4$ is usually high, that of atomic recombination is very low, and if we regard a pair of normal atoms in close proximity to one another as the extreme case of dissociation, the absence of an electric moment in the system forbids the quantised emission of radiation Thus reactions such as $2H \rightarrow H_2$, $2Br \rightarrow Br_2$, only occur in the presence of a third body or a surface, and the energy of combination transmitted to the third body is frequently emitted as chemiluminescence, a phenomenon readily observed with atomic hydrogen The energy of combination of atomic hydrogen is found to be sufficiently great to excite the OH molecule to emission, but not the mercury line λ2537 A in mercury atoms, this places the energy of dissociation of hydrogen between 94,000 and 112,000 cal per gram molecule

Atomic hydrogen, readily prepared by Wood's method, is a convenient source of many chemiluminescent experiments The afterglow of a number of gases, notably oxygen, nitrogen dioxide and nitrogen, when excited by the electric discharge, may all be regarded as chemiluminescent reactions in that the gases possess enhanced chemical reactivity in the glowing state The glow of nitrogen dioxide and nitric oxide and the after glow of Lord Rayleigh's active nitrogen are particularly brilliant, but the chemical processes involved are at present obscure It seems at least definitely established that active nitrogen contains at least two chemically reactive species, both atoms and excited molecules The cohesion of solid surfaces may be regarded as a species of chemical reaction in the solid state, and several of these reactions are found to be chemiluminescent, although frequently classified as tribo or crystalo luminescent reactions, the crystallisation of arsenious oxide and sugar exemplify this class of reaction

Other quasi chemical reactions which are luminescent include the fluorescence and phosphorescence excited in various substances, especially in solid solutions, by electron bombardment, some of the effects produced by the bombardment of minerals such as kunzite by high speed electrons being particularly brilliant Finally, we may observe the chemiluminescence obtained with certain bacteria such as *B fluorescens* and the reaction between luciferin and luciferase, the basis of biological light

Obituary

MR S S BUCKMAN

THE son of Prof James Buckman, a well known botanist and geologist of his day, Sydney Savory Buckman, born in 1860, early followed in his father's footsteps His attention was particularly directed to the Brachiopoda and Ammonites of the Inferior Oolite, and so early as 1883 he contributed a paper on the former to the *Proceedings of the Dorsetshire Natural History Field Club* Buckman will, however, be chiefly remembered for his work in connexion with the Ammonites, which he showed could be used as zone fossils for subdividing the Jurassic strata His study of these was extensive, and a monograph of those from the "Inferior Oolite Series" (never really completed) formed one of the Monographs of the Palæontographical Society (1887–1907), while he further traced their evolution through the successive strata, and in so doing was led to create a multitude of genera and species far beyond what had hitherto been deemed necessary

In connexion with all this work and subsidiary to it, Buckman published very many papers and memoirs on the classification of Ammonites and Brachiopods When his connexion with the Palæontographical Society was severed, Buckman began in 1909 a work on "Yorkshire Type Ammonites," consisting of photographic figures of the types accompanied by the original descriptions This was carried on until his eyesight failed six months ago The geological structure of the Inferior Oolite also received his attention, and he traced foldings in the beds that in some cases corresponded with those known to exist in the underlying Palæozoic rocks, thus bearing out Godwin Austen's principle of the continuity of folding with its economic consequences

The physical geography of south western England was the subject of a paper (*Natural Science*, 1899) far too little consulted by later writers, in which Buckman treated of the "Development of Rivers, and particularly the Genesis of the Severn" The capture of the headwaters of the Thames by the Severn has, perhaps, never been better set forth Buckman's extensive and original work became absorbed to such an extent into contemporary geological thought that few of the younger generation of geologists realise how much they owe to him

The value of Buckman's labours was recognised by the Geological Society, of which he was elected a fellow in 1882, by the award of the Murchison Fund in 1897, of the Lyell Fund in 1903, and the bestowal of the Lyell Medal in 1913 His researches stimulated many a geologist, and not in England alone, to a more detailed study of the rocks and their fossil contents, and all such he was ever ready to help in the most unselfish way His death on Feb 26 last was greatly regretted by all privileged to know him, and his memory will be cherished as one of the kindest of men

DR DU RICHE PRELLER

DR C S DU RICHE PRELLER died at his residence in Edinburgh on Feb 17 in his eighty-fifth year He was a notable representative of a type of which the numbers are steadily growing less, to the great loss of the community A successful professional man, with varied interests rising naturally out of the practice of his profession, he superimposed upon those interests others which in the course of his long life led to his appearing to include most branches of knowledge within his sphere

By training an engineer, Dr Preller's technical training was supplemented by wide studies in pure science, carried out in French and German universities as well as in Yorkshire His active career was spent mostly on the Continent, where he was engaged especially in railway and electrical undertakings in Germany, Italy, and Switzerland, being at one time chairman and chief engineer of the Limmat valley electric railway He was also interested in the lighthouses of the French coast From his absorption in hydro electric installations there arose naturally an interest in problems of glacial geology and of mountain form and structure generally Again, an inborn aptitude for languages —he belonged to a Huguenot family long settled in England—combined with long residence on the Continent, made him an excellent linguist, he spoke and read easily French, German, Italian, and Spanish He had also a great love of music, art, and literature, while travel was another favourite recreation

Though Dr Preller collected together a number of studies on the geology of Italy in a book published in three volumes as "Italian Mountain Geology" (1918–23), for which the Royal University of Florence made him an honorary doctor of science, most of his scientific writings took the form of essays, papers, and letters contributed to technical, scientific, and other periodicals He was an occasional contributor to NATURE, but many of the papers of his later years, after his settlement in Edinburgh in 1912, appeared in the *Scottish Geographical Magazine* These dealt with a great variety of subjects, including the old problem of Hannibal's route across the Alps With interests so widely diffused great originality was not to be expected, and accuracy in detail at times left something to be desired, but for these qualities we look to the specialists The great importance of such men as Dr Preller is that they act as liaison officers between the educated public and scientific specialists Their steadily decreasing numbers is to be regretted in that the specialists are always tending to become more and more unintelligible even to their fellows in other branches

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WE regret to record the death of Dr Humphrey Purnell Blackmore, widely known as an archæologist, which took place at Salisbury on Feb 2, at the age of ninety-three years He was educated at Queenwood College and qualified in medicine at the earliest possible age While in practice at Salisbury he took up the study of geology The results of his intimate study of local conditions were published in the Geological Survey account of Wiltshire He contributed to the Blackmore Museum, which was founded by his brother, a valuable series of palæontological remains which he himself had discovered in the local gravels When the Salisbury and South Wilts Museum was founded, now more than sixty years ago, it was very largely due to his activities, and he took a very considerable share in determining its methods and arrangement His interests in archæology were wide, and brought him into intimate touch with the most prominent archæologists of his day, among the more noteworthy being Sir John Evans, Sir Augustus Franks, Lord Avebury, and Sir William Boyd Dawkins Although to a later generation he was more widely known by name than personally, he was always ready to throw open the valuable collections in his house at Salisbury to research workers With his death, and that of Sir William Boyd Dawkins, has finally passed away that generation of pioneers which founded British prehistoric archæology and raised it to the foremost place in the study of the culture of early man

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THE death is announced of Dr Joseph Goldberger on Jan 17 According to a *Daily Science News Bulletin* (Science Service, Washington, D C) he was born in Austria in 1874, and at the age of six emigrated with his parents to the United States Twenty years later he joined the U S Public Health Service and soon afterwards was attached to the Hygienic Laboratory, Washington His greatest contributions to science were his studies on the nature, cure, and prevention of pellagra, which he determined to be a food deficiency disease dependent upon lack of fresh and proper proteins He discovered that yeast is a preventive in the absence of fresh meat and milk He also contributed studies on yellow fever, dengue, measles, and influenza

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WE regret to announce the following deaths

Mr Edward Davidson, for many years secretary and treasurer of the Royal English Arboricultural Society, on Mar 4

Dr Alex Hill, secretary of the Universities Bureau of the British Empire and formerly Master of Downing College, Cambridge, and Principal of University College, Southampton, on Feb 27, aged seventy two years

Mr John Hyde, from 1897 until 1905 chief of the bureau of statistics of the U S Department of Agriculture, known also for his work on the economic effects of disease, food and population, etc, on Jan 18, aged eighty years

Dr Frederic A. Lucas, director of the American Museum of Natural History from 1911 until 1923 and since honorary director, and a foreign member of the Zoological Society of London, on Jan 9, aged seventy-six years

Sir John Denison Denison Pender, G B E, K C M G, chairman of the Eastern and Associated Cable Companies, on Mar 6, aged seventy three years.

News and Views.

ON p 415 of this issue we publish the first authoritative account to reach England of the skeleton discovered in January last in the Springbok Flats, Transvaal The discovery has already been announced in cabled dispatches appearing in the English press, but the detailed account of the circumstances of its discovery and the results of the examination of the skeletal remains which Dr Broom now gives make it possible to form a more adequate estimate of its importance Its chief point of interest is that not only is the skull that of modern man, but it bears a close resemblance to the Cro Magnon type of the European upper palæolithic age In this it agrees with the Boskop skull, but another feature which it has in common with that skull and in which they both differ from the Cro Magnon is, that while the latter is high, they are both low This is important, as by some the Boskop skull was thought to have suffered from post mortem deformation The long bones of the new skeleton, though much broken, by the estimate of their length would bear out the resemblance to Cro Magnon man in point of being large The Bushveld skull, as Dr Broom suggests the new find should be called, resembles the Boskop skull in that the eyebrow ridges are not prominent and both are large brained Although not so long as the Boskop skull, to which an estimated length of 210 mm was given, the Bushveld skull measures 195 mm This, on an estimated breadth of about 144 mm, gives a cephalic index of 74 Although, as Dr Broom points out, the new skull differs from the Boskop skull in several particulars, it confirms the evidence of the earlier find of the existence in South Africa of an early large brained race But, whereas the Boskop skull was regarded as showing affinities with no existing race in South Africa, Dr Broom is inclined to see in the Korannas the descendants of Bushveld man

THE suggested correlation of the Bushveld man with the middle palæolithic of South Africa, through the association of the remains with an extinct species of buffalo also found in association with the Hagenstad type of stone implement, adds considerably to the interest and importance of the find This may be still further enhanced when it is possible to bring it more closely into relation with the investigations which Mr Leakey is carrying out in Kenya, where it is evident from the communication which appeared in the *Times* on Mar 7 that finds of a crucial character are possible at any moment The discoveries of this season which Mr Leakey announces are of a sufficiently surprising nature In last season's excavations at Elmenteita a Mousterian layer had been reached below the Aurignacian level in the cave known as Gamble's Cave II This year, two occupation levels with industries of typical Aurignacian facies have been found below the Mousterian horizon, belonging to the same Second Pluvial period as that horizon. This sequence has been confirmed at a number of sites As there is no evidence of any mingling of the Mousterian and Aurignacian industries, it can only be concluded that the Mousterian in East Africa represents an actual racial intrusion and not merely a cultural influence, while, further, the reversal of the sequence normal in Europe points to the immigration of a race from outside into an area in which the Aurignacian was either the indigenous culture or, at any rate, in which it was sufficiently near its place of origin to permit of its earlier penetration This is what might be expected on the view of the African origin of the Aurignacian culture Two skeletons have been discovered which agree with previous discoveries in associating *Homo sapiens* with Aurignacian industries Mr Leakey, holding that any human remains discovered in association with the Mousterian industry will be of the Neanderthal type, suggests that such remains may link up man in East Africa with Rhodesian man

THE centenary of King's College directs attention to an educational institution which has the distinction of being one of London's oldest colleges and the misfortune of being one of the poorest It is the worst endowed College in Great Britain, and yet the numbers of students have doubled since the War, and the high standard both of its teaching and research is being steadily maintained While the appeal for £350,000 which has been launched is wide, in that it embraces the improvement of buildings, the provision of endowments, scholarships, and bursaries, there is one particular aspect which we would recommend to our readers The College has always occupied a leading place in its work for scientific progress It was the first English college to establish either a physics or a bacteriological laboratory The work done in the physics and electrical departments is particularly distinctive Wheatstone invented the telegraph, Maxwell disclosed the principle to which broadcasting owes its origin, while in more recent times Prof O W Richardson formulated the laws underlying the action of wireless valve filaments Important wireless research is at present being pursued by Prof E V Appleton

THE electrical industry is largely indebted to work carried on at King's College The theory of the parallel running of electrical alternators as used to day in all the large power stations, and the invention of the three wire system of supply, were first propounded by Prof John Hopkinson The present professor of electrical engineering, Prof Ernest Wilson, has carried out important investigations on the corrosion of metals such as are used for overhead wires and are exposed to the London atmosphere Neither the physics nor the electrical engineering departments has an endowment income They are almost entirely dependent upon a fluctuating student fee income It is now proposed to raise a sum of £50,000 to endow chairs in these two departments The amount is modest enough in comparison with the wealth of the wireless and electrical industries, and donations to either branch of the College would be a recognition of indebtedness and an encouragement for future

research Donations may be sent either direct to King's College, Strand, W C 2, or to the College bankers, Messrs Coutts and Co, 440 Strand, W C 2

At the South Africa meeting of the British Association in July next, the Council will nominate Dr F O Bower, F R S, lately Regius professor of botany in the University of Glasgow, as president of the Association for the year 1930, when the meeting will be held in Bristol The Association has received from the Court of Common Council (the Corporation of the City of London) the expression of a hope that London will be selected as the place of meeting in the centenary year, 1931, and offering entertainment to the Association in that event This invitation has been accepted, and the centenary meeting will therefore be the first ever held in London

In view of the importance of the wool industry to South Africa, it is fitting that wool research should be a strong feature at the meetings of the British Association this year Among those who have already signified their intention of being present are Prof Aldred F Barker, head of the Textile Department of the University of Leeds, Dr S G Barker, Director of Research of the British Research Association for the Woollen and Worsted Industries, and Dr J E Nichols, also of the Research Association, who is at present engaged on a sheep and wool survey of the British Empire Principal H Richardson, head of the Technical College, Bradford, is also expected to attend Dr J E Duerden, Director of Wool Research of the Union of South Africa, will give an account of the wool investigations in progress in the South African Department of Agriculture, and others will deal with various nutritional and genetical experiments Mr E N S Warren, head of the Sheep and Wool Section at the Grootfontein School of Agriculture, will describe the instructional course given there, which is admitted to be one of the foremost in the world

The inauguration of a television broadcasting service in Great Britain is at present being considered by the Post Office officials Great progress has recently been made at the Baird laboratories and very satisfactory demonstrations of land line transmissions have been given on a 'televisor' It is quite easy to 'tune in' the picture by one control and 'frame' it correctly by the other control The pictures are still somewhat limited in size, but excellent 'head and shoulders' reproductions are given, and in conjunction with a loud speaker give a very interesting performance Considerable detail is given in the picture—the time, for example, on the performer's watch can be easily read A high tension pressure of 350 volts is required for the home televisor, but if an alternating current lighting supply is available, this can be readily obtained by an 'eliminator' At present the sets are designed for a fixed wave length of 200 metres (1500 kilocycles) It is, perhaps, too early to say what is the narrowest band of frequencies that is necessary to transmit a sufficiently satisfactory picture In the event of the establishment of a television broadcasting service, it would be advisable to have as narrow a band as possible so as to avoid interference with the ordinary broadcasting and other services Everything depends on how much flicker and lack of detail can be permitted without appreciably detracting from the pleasure of the 'looker on' Television for the theatre seems to be an easier problem than television for the home As this would be worked throughout by experts, the large performance factor of safety required for home sets would be unnecessary

In every continental area the number of wave lengths available for broadcasting is strictly limited The radiation from an aerial may be considered as made up of rays parallel to the surface of the earth and of rays inclined to the surface The latter radiations suffer very little attenuation, and, striking the conducting layer, get bent down towards the earth and sometimes produce interference with parallel waves Such interference has been noticed between stations 2000 miles apart In a paper by P P Eckersley and A B Howe, read to the Institution of Electrical Engineers on Mar 6, a method of getting over interference difficulties by using the same wave length for several stations is discussed Three other methods have been suggested The first is by securing a proper international agreement between the nations, the second by designing all transmitting aerials so that only radiations parallel to the earth's surface are emitted, and the third by using only a few high powered stations instead of many low power stations Most broadcasting authorities throughout the world are adopting the third of these methods In 1924, Captain Eckersley suggested in addition that several broadcasting stations in each country might be operated on the same wave length At the present time Edinburgh, Hull, Bradford, and Bournemouth share the same wave length with satisfactory results The case of Bradford is interesting, as it is only about 60 miles from Hull When Bradford shared a wave length with other European stations the good service range was only about half a mile from the aerial Now, although it has the same wave length as Hull, it has a good service range exceeding five miles The chief sphere of usefulness of this new method is to bring first class service to isolated towns Low powered stations and short wave lengths would be used, as all the regional high power stations need long wave lengths The method should appreciably relieve the broadcasting conditions in Europe

The Institute of Metals, founded for the study of Non Ferrous Metallurgy in 1908, which has just held its twenty first annual meeting, had an initial membership of about 250 To day the roll of its members exceeds 2000, of whom about two thirds are British and Empire members, while the remaining one third consists of foreign members At the time of its formation many doubts were expressed whether such an institute could be formed and maintained, and whether it would fulfil any really useful function When the successful career of the Iron and Steel Institute was cited as an encouraging example, the doubters pointed out that the non ferrous industries were much smaller, less wealthy, and less advanced

from a technical and scientific point of view It was even feared that manufacturers might not wish to support such an institute and that they would decline to allow the members of their staffs to take part in its meetings for fear of divulging confidential information Fortunately, the small band of enthusiastic founders of the Institute did not permit themselves to be deterred by such misgivings, and as soon as a start had been made it became abundantly clear that a real need existed for an institute dealing with the non ferrous metals From the very beginning the Institute prospered Its membership began to grow steadily and still continues to increase to day, while the value of its work and influence stands fully recognised both in Great Britain and abroad Its first three presidents were the late Sir William White, the late Sir Gerrard Muntz, and the late Prof W Gowland, representing respectively the user, the manufacturer, and the scientific student of metals This order of rotation in filling the presidential chair has been followed, with a few exceptions in special circumstances, throughout the past history of the Institute It is intended to emphasise the fact that the Institute seeks to serve the interests of all those directly concerned with the non ferrous metals, whether as users, manufacturers, or scientific investigators and teachers of metallurgy

A provisional notice of the forthcoming International Congress of Forestry Experimental Stations, to be held at Stockholm and elsewhere next July, has already appeared in Nature (Dec 1, 1928, p 852) The sessions of the Congress will take place in Stockholm during the week July 22-27, an excursion being paid during the week to visit forests at Noorköping and Katrineholm Although the deliberations of the Congress are confined to a week, the programme laid down is more comprehensive Two extensive tours, one in the south and the other in central and north central Sweden, are projected, each covering eight days, during which a considerable part of the country will be traversed Those members wishing to participate in the first tour will assemble at Malmö on July 14, arriving at Stockholm on July 20 During this period interesting forests will be visited at Dalby, Furen, Bokenäs, Malingsbo, Siljansfors, and in the region of Siljan and Domnarvet A number of private forests (pine, spruce, and beech) will be visited on this southern tour Also the pine and spruce State forests of Malingsbo in Dalarna, where the College of Forestry has instructional forests, and the experimental forests of Siljansfors, which are under the management of the Experimental Station and in which research work is undertaken This excursion will conclude with a trip through the beautiful country round Lake Siljan, when the rafting in the Daläven River will be seen and a visit paid to the town of Falun, an ancient ore mining and forest industries centre

The second excursion which has been arranged for the International Congress of Forestry Experimental Stations will prove of even higher interest Members will leave Stockholm for Bispgården on July 28 and will visit forests and forest industrial works at Kulbäcksliden, Svartberget, Lycksele, Hoting, Frösön to Åre, situated in the highlands of Jämtland, where amongst other things of interest the wonderful waterfall of Tännforsen will be viewed The intention of the northern tour is to demonstrate the forestry problems of Norrland and the difficulties incurred in slow growing northern forests with a more or less sterile soil Rafting and the industrial side of forest work in Sweden, which is of such great importance to the commercial well being of the country, will be seen The programme laid down for this Congress is extensive and can scarcely fail to be productive of work of importance to forestry science, whilst the members will have an opportunity of becoming acquainted with some valuable aspects of Swedish forestry methods

The following were elected fellows of the Royal Society of Edinburgh at a meeting held on Mar 4 Dr S G Barker, director of research, British Research Association for the Woollen and Worsted Industries, Leeds Dr F Bath, lecturer in mathematics, University of St Andrews, Mr G Bennet, lecturer in mechanical engineering, Heriot Watt College, Edinburgh, Dr A Calder, assistant in the Animal Breeding Research Department, University, Edinburgh, Dr G Coull, pharmaceutical chemist, of Leith, Prof E W H Cruickshank, Physiology Department, Dalhousie University, Halifax, Nova Scotia, Mr D Kennedy Fraser, psychologist to the Education Authority, Glasgow, Mr T Henderson, actuary of the Savings Bank of Glasgow, Dr Sunder Lal Hora, senior assistant superintendent, Zoological Survey of India, Calcutta, Prof J Kendall, Chemistry Department, University of Edinburgh, Mr J R Little, general manager and secretary of the Century Insurance Co, Edinburgh, Prof D N M'Arthur, Department of Agricultural Chemistry, West of Scotland Agricultural College, Glasgow, Mr J Mackie, mathematical master, Leith Academy, Leith, Mr W Mercer, lecturer in clinical surgery, University of Edinburgh, Mr H Moir, president, United States Life Insurance Co, in the City of New York, Prof F W Ogilvie, Department of Political Economy, University of Edinburgh, Dr J F V Phillips, botanist, Tanganyika Territory, Mr S Read, Edinburgh Academy, Mr R A Robb, lecturer in mathematics, University of Glasgow, Principal J C Smail, Heriot Watt College, Edinburgh, Prof Sydney Smith, Department of Forensic Medicine, University of Edinburgh, Dr T Southwell, lecturer in helminthology, School of Tropical Medicine, Liverpool, Mr A C Stephen, assistant, Natural History Department, Royal Scottish Museum, Edinburgh, Dr B P Wiesner, lecturer in sex physiology, University of Edinburgh

The United States Bureau of Mines has issued its report upon coal production in 1926 It consists, as usual, of numerous detailed statistical tables, whilst there is also much interesting information explaining the changes from year to year in the statistics quoted The greater part of the report is interesting only to coal workers in the United States, but there are some passages which coal producers, and especially coal miners in Great Britain, would do well to take to

heart Thus the report states that "The foreign demand was unusually intense because of the seven months' suspension of production in Great Britain The general walkout of the British miners on May 1 immediately started discussion of exports from this country" "A gain of approximately 14,000,000 net tons of shipment to Europe represented the greater part of the growth in the sea borne trade in 1926 This coal displaced former British tonnage in the main and went chiefly to the United Kingdom, Irish Free State, Italy, and France"

ENGINEERS engaged in designing will be interested to know that Messrs Adam Hilger, Ltd, are now making Prof Coker's well known apparatus for the study of the stresses in engineering structures by means of the double refraction which stresses produce in transparent models, and the effect this double refraction has on either plane or circularly polarised light passing through them Models of celluloid, stressed in their own planes, are used up to 3 inches long In circularly polarised light the areas of maximum stress are immediately apparent, and for many purposes this will be sufficient for the engineer If the actual magnitudes and directions of the principal stresses at each point are required, a more detailed examination under plane polarised light and with an auxiliary sheet of the same celluloid in simple tension used as a standard of stress is necessary

IT has well been said that the aspiration after the understanding of human nature and human actions is the key to much that is characteristic of the present century It is beginning to be realised that science is the new humanism, and that industrial aspects of it have to be considered not merely as profitable enterprises but also in relation to social welfare We therefore welcome the announcement of the publication of a new monthly magazine—*The Realist*—which will aim at presenting contacts of scientific discovery and other forms of creative expression with social, economic, and political affairs of the modern world The magazine has a strong editorial board representative of many fields of progressive thought and action, and it should make a wide appeal to intelligent citizens who seek something more substantial than they usually find in journals devoted to literary and political trivialities The first number is to appear on Mar 26, and will be issued by Messrs Macmillan and Co, Ltd, for the Realist Publishing Co, 25 Victoria Street, S W 1

THE Torquay Natural History Society shows satisfactory progress In spite of the fact that the building of an extension to the Museum interfered with the ordinary course of museum work, a varied programme of twenty two lectures was carried through The addition of a second storey to the museum has permitted the exhibition of a loan collection of ethnographical specimens and of much material formerly stored away The activities of the Society are carried on by a series of sections with specialised interests, the most lively being the archæological, the botanical, and the entomological In each of these, papers of general and local interest were read, and some of these have been published in the *Transactions*

THE Report of the Museums of the Brooklyn Institute of Arts and Sciences for 1927 gives a great impression of activity and progress, not only in the field of exhibition pure and simple, but also in many side activities aiming at the education of the student and the people in general The Department of Natural History has been given much additional room for expansion, many new galleries, three of which have been converted into European period rooms, have been opened, a large annex has been adapted for the Children's Museum at a cost of some £10,000, and a lunch and tea room has been created The energy of the staff is indicated by the fact that ten special exhibitions of various art collections and eight exhibitions of prints were held in the course of the year Special educational activities include the institution of a press for printing lithographs for the use of students, the formation of a class in clay modelling for children in the elementary schools, the exhibition of motion picture films portraying the "Chronicles of America," and zoological subjects (purchased from Raymond L Ditmars) for school children, as well as lecture courses for the public for teachers, and for students The Children's Museum with its loan exhibits of natural history specimens, its school visits helped by three teachers assigned by the education authorities, its summer field trips, and many other activities, ought to instil the scientific mood at a period when it is most likely to have a telling influence The cost of running these excellent museums during the year was roughly £43,000 for the Central Museum, and £4700 for the Children's Museum

THE G J Symons Memorial Lecture of the Royal Meteorological Society will be delivered on Mar 20 at 7 30 P M, by Mr R A Watson Watt who will take as his subject "Weather and Wireless"

DR L F HEWITT has been appointed bio chemist at the Metropolitan Asylums Board's antitoxin establishment, Belmont Laboratories, Sutton, Surrey Dr Hewitt is at present Gibbons Research Fellow at the London Hospital, and was formerly research chemist, Medical Research Council, Mount Vernon, Hampstead

A VIOLENT earthquake was recorded at Kew Observatory on Mar 7 The first tremors reached the observatory at 1 hr 46 min 36 sec G M T The distance of the epicentre is estimated at 5400 miles, and the bearing is 7° W of N, corresponding with a position near the Aleutian Islands, lat 50° N, long 168° W

AN additional evening meeting of the Royal Geographical Society will be held on Monday, Mar 25, at 8 30 P M, at the Polytechnic Theatre, Regent Street, when Sir Douglas Mawson will give an account of recent work on the fjords of New Zealand and will show the kinematograph film of his Antarctic Expedition of 1911–1914, not before shown in England in its final form

MAJOR H O D SEGRAVE established a new speed record on Mar 11 at Daytona Beach, Florida, with an average of 231 36226 miles an hour Major Segrave was driving his Irving Special racing car *Golden Arrow*,

and covered the mile course in each direction at just over 231 miles an hour The *Golden Arrow* has a 12 cylinder Napier Lion engine which develops 930 h p and is not supercharged, the body of the car consists of three stream line forms The previous highest speed, 207 55 miles an hour, was attained by Mr Ray Keech driving Mr J M White's Triplex car on April 22, 1928

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —An assistant veterinary inspector under the Surrey County Council—The Clerk of the County Council, County Hall, Kingston upon Thames (Mar 20) A lecturer in electrical engineering at the Rugby College of Technology and Arts—The Organiser of Further Education in Rugby, 61 Clifton Road, Rugby (Mar 20) A head of the Mathematics Department and organising assistant to the Principal of Leeds Technical College—The Director of Education, Education Department, Calverley Street, Leeds (Mar 23) An assistant lecturer in botany in the University of Bristol—The Secretary, The University, Bristol (Mar 25) A deputy curator of the Sunderland Public Libraries, Museum, and Art Gallery—The Chairman of the Libraries, Museum, and Art Gallery Committee, Town Hall, Sunderland (Mar 25) A lecturer in physics at the Chelsea Polytechnic—The Principal, Chelsea Polytechnic, Manresa Road, S W 3 (Mar 28) A demonstrator for laboratory work in physics and electrical engineering at the Royal Naval Engineering College, Keyham (Plymouth)—The Secretary of the Admiralty (C E Branch), Whitehall, S W 1 (Mar 31) A head of the pharmacy department of the Leicester College of Technology—The Registrar, College of Technology, Leicester (April 3) A lecturer in the Department of Mining of the Imperial College of Science and Technology—Prof S J Truscott, Imperial College of Science and Technology—Royal School of Mines, South Kensington, S W 7 (April 15) A professor of biochemistry in the University of Alberta—The Secretary of the Board of Governors, University of Alberta, Edmonton, Alberta, Canada (May 14) A junior chemical assistant to the Research Association of British Flour Millers—The Director of Research of the Association, Old London Road, St Albans A senior science mistress at the County School for Girls, Beckenham—The Head Mistress, County School for Girls, Beckenham A bacteriologist in the Malayan Medical Service—The Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, S W 1

Our Astronomical Column

TWO NAKED EYE SUNSPOTS —Two groups of sun spots, large enough to be seen with the naked eye, have recently been on the sun's disc at the same time The larger of these was a stream, with a big composite leader spot, crossing the central meridian on Mar 11 It was the return or revival of a group in the previous rotation with central meridian passage on Feb 12

The second group consisted of a single spot, fairly regular in outline, and showing bright projections partly across the umbra, there were small companion spots and a subsidiary stream southwards The following table gives other details of the two groups

No	Date on Disc	Central Meridian Passage	Latitude	Area
3	Mar 2–14	Mar 8 3	7° S	1/2000
4	Mar 5–17	Mar 11 0	10° S	1/800

(Areas express proportion of hemisphere covered)

CHANGES IN THE EARTH'S ROTATION —A paper by the Astronomer Royal and Mr R T Cullen was read at the meeting of the Royal Astronomical Society on Mar 8, in which the residuals in longitude of the sun for the last 150 years were compared with those for the moon It was found that a much greater accordance was produced by deducing the sun's longitude from the observed Declinations in the neighbourhood of each equinox, than by deducing it from the Right Ascensions The early observations of Right Ascension of the sun are affected by abnormal errors which do not enter into the Declinations to the same extent

The new reduction leads to a much closer resemblance between the curves of solar and lunar residuals than has previously been obtained, and thus strengthens the hypothesis that the cause of these fluctuations lies in the earth's rotation, not in the bodies themselves

MEASUREMENT OF STELLAR RADIATION —The recent considerable advances made by Pettit and Nicholson in the knowledge of stellar radiation has been made possible largely through the great 100 inch Hooker telescope, combined with the extremely delicate thermocouples and refined methods of measurement introduced by these two pioneers Their latest results are given in the *Astrophysical Journal*, vol 68, p 279, which includes an interesting account of the construction of the thermocouple This delicate operation, in which wires of about 0 03 mm are used, has to be performed under a microscope, and the resulting thermocouples are capable of measuring radiometric magnitudes with an uncertainty of only 0 1 of a magnitude A discussion of the observing methods used and the reduction of the observations is followed by the results obtained for the 124 stars so far observed Those are reduced to a homogeneous system of radiometric magnitudes, heat indices, and water cell absorptions, corresponding to the standard conditions of (1) the star in zenith, (2) two reflections from fresh silver, and (3) a rock salt window in thermocouple The corrections required to reduce to no atmosphere and for the total radiation reaching our system are given, as well as the computed bolometric magnitudes

DETONATING FIREBALL IN NEW ZEALAND —There has been evidence of a widely awakened interest in astronomy of late years in New Zealand One of the directions of its manifestation is the careful observation and discussion of meteors Mr R A McIntosh describes in *B A A J* for February a brilliant fireball that appeared over the Coromandel Peninsula (North Island) on the night of Oct 27, 1928 As the moon was full, and yet the object was so conspicuous, the magnitude is estimated as − 15, the explosion was seen by three observers, the meteor separated into three or four portions, which quickly died out The height at commencement was 75 miles, at the end 25 miles, the visible track being 107 miles long and the velocity 27 miles per second The explosion shook the houses, and was heard over a large area A faint trail was seen for 2½ seconds The radiant was at 6° + 24°, near Alpha Andromedæ

Research Items

CLIMATE AND HEALTH —The statistical relations between climatic factors and human health has been investigated by Dr A Wallen in a publication of the *Statens Meteorologisk Hydrografiska Anstalt*, Bd 5, No 1 of Stockholm, entitled "Vädevlekens Samband med Hälsotillståndet" Dr Wallen has studied the correlations between the mortality and health of Stockholm and Göteborg on one hand, and pressure, temperature, humidity, precipitation, and diurnal variation on the other No particular relationship is found between pressure and health, but mortality increases during high pressure both in summer and winter This, however, may be due rather to the associated high temperature in summer and low temperature in winter A close relation appears to occur between temperature and health Humidity also plays an important rôle Dry seasons at all times of the year show an increase in the mortality rate, and winters and springs with a high humidity are also marked by a high mortality No relation was traceable between the amount of precipitation and health or mortality Considerable diurnal variations in temperature or in pressure show correlations with an increase in the mortality rate Dr Wallen also traces correlations between meteorological factors and the number of workmen on sick leave in a large factory with 1000 employees A close correlation was shown in an increased number of cases during low barometric pressure The paper contains a large number of graphs and statistical tables, and a useful bibliography of the subject

HANDWRITING —*Science Progress* for January has an article on experimental graphology by R Saudek Handwriting being a very personal activity, one would expect on *a priori* grounds that it would be possible to deduce from it something of the personality of the writer Numerous attempts have certainly been made and while some people would seem to have had some success in individual cases, yet the scientific treatment of the subject is very recent From the legal point of view the aim of the graphologist is to discover whether the questioned document is the work of the reputed writer, and, if it is not, to prove the identity of the handwriting in its inconspicuous characters with that of the suspected person The assumption on which the expert relies is that the inconspicuous features of the handwriting cannot be consistently disguised in a manuscript of any length The problem of the diagnosis of the character of the writer is more complicated The writer of this article has subjected handwriting to a detailed analysis, and asserts that there are at least twelve factors that co operate in the formation of the individual writing These factors include the writing instruments, the degree of maturity of the writer, the acute physiological condition of the writer, and the speed of the act of writing etc Detailed explanations are given and specimens of handwriting illustrating the various points The kinematograph has proved useful in distinguishing some of the laws The research is interesting as marking a beginning of the study of this subject, though one is left with the feeling that much yet remains to be done

WILD BIRDS AND DISEASE IN THE POULTRY YARD — Various investigators have shown that a number of species of wild birds occasionally harbour a gape worm identical with that which causes severe epidemics amongst poultry (*Syngamus trachea*) Odd records refer to the pheasant, thrush, magpie, jay, and jackdaw A more serious infestation may occur in the starling, in which Lewis found that, in the Aberystwyth district, 169 out of 482 (35 per cent) carried the parasite Charles Elton and Frank Buckland have now discovered that a much higher percentage of the rooks in the Oxford district are similarly affected (*Parasitology*, vol 20, December 1928) The samples are small, but the results are striking of eight adults examined, four contained gape worms, and 31 out of 33 young rooks Rooks and starlings are frequent visitors to the poultry yard, and the possibility that they may be responsible for the distribution of gape worms amongst domestic fowls deserves immediate investigation The very high incidence of the presence of gape worms amongst young rooks may account in part for the mortality which they are known to suffer in the nest, and this also may be a factor of some economic importance

PARASITIC WORMS OF THE WILLOW GROUSE —A paper by Johan Huus (*Bergens Mus Aarbog*, 1928) forms one of the contributions to the extensive investigation recently completed on the biology of the willow grouse in Norway The alimentary tracts of 517 birds were examined and four species of worms obtained, namely, two nematodes—*Ascaridia compar*, *Capillaria longicollis*, and two cestodes—*Raillietina urogalli* and *Weinlandia microps* *Ascaridia compar* was found in the jejunum of 190 of the birds examined A careful account is given of the morphology, the distribution and the biology of the worm The larvæ of *Ascaris lumbricoides* and of *Ascaridia galli* are known to pass from the intestine into the blood stream and via the heart to the lungs, where they escape into the alveoli, and thence come into the trachea and pharynx, from which they pass into the stomach and intestine The author believes that the larvæ of *Ascaridia compar* have a similar course, for the youngest examples found in the duodenum were 3 mm long and were undergoing their last ecdysis There is no evidence that this worm is pathogenic, the passage of the larvæ through the lungs, especially in young chicks, may be harmful *Capillaria longicollis* was found only in three birds, in the duodenum *Raillietina urogalli* was present in the jejunum of 57 of the birds examined, and *Weinlandia microps* in the duodenum in 60 cases The author points out that parasitic worms were not present in the cæcum of the birds examined

RESEARCHES ON COPEPODS —Mr A G Lowndes, of Marlborough College, in continuation of his researches on freshwater copepods, has published two interesting papers, "Freshwater Copepoda from the New Hebrides" (*Annals and Magazine of Natural History*, Ser 10, vol 1, June 1928) and "The Result of Breeding Experiments and other Observations on *Cyclops vernalis* Fischer and *Cyclops robustus* G O Sars" (*Internat Revue der ges Hydrobiol u Hydrographie*, Bd 21, Heft 3/4, 1928) The first of these deals with a collection of copepods made by Dr J R Baker from a large lake on the Island of Gaua The lake is more than 300 feet deep, the pH at the surface and middle layers was 8 5 and the temperature 25° C Five species of copepods only were obtained, all but one well known and of wide distribution It is very interesting to find that in the majority of cases little or no difference in structure is visible between the forms from the New Hebrides and those from the British Isles and elsewhere No Calanoids were found in this collection In a sample from Hog Harbour, Santo, *Cryptocyclops anninæ* occurred in abundance in empty coco nut shells In the second paper Mr Lowndes describes the result of breeding together the two copepods *Cyclops vernalis* and *Cyclops robustus*, the object of the work being to decide whether *C robustus*

should be regarded as a separate species or only as a variety of *C vernalis* The specific characters are based almost entirely on the spine formulæ and on the nature of the setæ Mr Lowndes has shown in previous breeding experiments on *Cyclops* that the spine formulæ may be exceedingly variable and too much importance must not be attached to these for the identification of species The experiments were carefully carried out, and in addition cultures were made from the adult female of *C robustus* which gave rise to *C vernalis* *C vernalis* was successfully crossed with *C robustus* Both forms occur together in the same pond with every gradation between the two It is concluded from these observations that *Cyclops robustus* is not a separate species, but only a form of *Cyclops vernalis*

FISHES FROM FLORIDA AND THE WEST INDIES — In the paper under this title (*Proceedings of the Academy of Natural Science of Philadelphia*, vol 80, 1928), Mr Henry W Fowler reports on collections obtained in Florida, the Bahamas, Haiti, Porto Rico, Saint Lucia, and Dominica The specimens, except the Porto Rican collection are in the Academy of Natural Science of Philadelphia Several hundred species are recorded, but none is new, although there are new localities for many of the fishes and some are specially interesting in their distribution The author also mentions nineteen examples of *Rivulus hartii* (Boulenger) from Pitch Lake, in Trinidad, British West Indies which were presented to the Academy by Dr Judson Daland in April 1928 Some of the species from Florida are new to the United States fauna These include a specimen of *Rivulus cylindraceus* Poey which is re described There are some rare fishes from the Bahamas One specimen of *Sparisome radians*, 81 mm long, was taken from the stomach of *Serranus striatus* From Bermuda three examples of *Halichœres radiatus* are recorded and one of *Callyodon plumbeus* A collection of 69 species come from Haiti obtained by Mrs James Bond in the Porto Prince market Valuable colour notes are given for many of the fishes

THE BLOOD OF INVERTEBRATES —The holothurian *Caudina* is a favourite subject for physiological research and is specially interesting, for not only is there hæmoglobin in its blood, but also this is contained in corpuscles, as Hogben recently described in a South African *Cucumaria* Two papers in the *Science Reports of the Tôhoku Imperial University* (4th series (Biology), Sendai, Japan, vol 3, No 4, Fasc 1, 1928) deal with the subject In "Chemical Studies on Sex Differences of Blood Protein in *Caudina chilensis* J Muller," Tetsutaro Tadokora and Shukichi Watonabe have followed up their researches on sex differences in the blood protein of mammals They contend that similar differences are found in *Caudina* Mr Nobukuki Kawamoto ("Oxygen Capacity of the Blood of Certain Invertebrates which contain Hæmoglobin") uses the mollusc *Andara inflata* as well as *Caudina* for his experiments Both contain hæmoglobin in the blood corpuscles, and the present work was undertaken in order to make a comparison with the blood of invertebrates having no hæmoglobin, such as those used recently by other workers (*Helix*, *Octopus*, *Homarus*, *Astacus*, *Cancer*) It is shown that compared with the higher Mammalia, the blood of *Andara* and *Caudina* absorb much less oxygen, but compared with the invertebrates quoted, the oxygen capacity is much greater It is also greater that that of sea water

EARLY HISTORY OF COTTON —A N Gulati and A J Turner, of the Technological Laboratory of the Indian Central Cotton Committee, have an interesting note on the early history of cotton in *Bulletin* No 17, Technological Series No 12, issued in October 1928 by this Committee (The same paper appears in the *Journal of the Textile Institute*, 20, pp T1 19, January 1929) The earliest known mummy cloths in Egypt, according to Petrie date from about 5500 B C and are made of flax No Egyptian mummy cloths appear to have been made of cotton, but mummy cloths of cotton have been found in Peru, where one species of *Gossypium* seems to be indigenous Recently, scraps of cotton material have been found amongst the remains of the prehistoric civilisation unearthed at Mohenjo daro in Sind These remains belong to the three latest cities erected on this site, which are ascribed to dates between 3500 B C and 2400 B C Messrs Gulati and Turner have made as full an examination of this material as the condition of its preservation permits, and conclude that the cotton is not of the *G herbaceum* type, but more closely related to the coarser fibres of the *G arboreum* type One sample of string found in earthenware had a purple colour, a few tests made on this sample suggested that the dyestuff originally employed was of the madder type

ABACÁ A LITTLE KNOWN PHILIPPINE FIBRE The Cordage Institute of the United States has made possible a detailed study of the conditions of cultivation and production of 'abacá' fibre This product is obtained from the outer, lower side of the long fleshy leaf stalks of *Musa textilis* Née which overlap to form the main stem of this plant The industry is indigenous to the Philippines, where the fibre has been known since Pigafettas' diary of Magellan's trip around the world (1519), in which the name first appears A million or more bales of fibre from cultivated varieties of this plant are annually exported from the Philippines whilst fibre is now also being produced from the same plant in Borneo, Java, and Sumatra During recent years a scientific study of the crop and its product has been initiated, and the *Philippine Journal of Science*, Vol 37, No 1, Sept 1928, contains a series of papers by P L Sherman, Cordage Institute Fellow, and his colleagues of the Bureau of Science, Manila, which give the first results of this work These papers deal largely with the soil conditions and the state of the fibre as originally prepared Active fermentation processes are at work in the soil owing to the mass of rotted vegetable material from the leaf debris left after cutting out the fibres partly as a result the extracted fibre is usually somewhat full of acid materials, and the writers point out that unless it is thoroughly dried before it leaves the collecting ground, there is great danger of rapid deterioration in storage

FOSSIL OSTRACODA OF ITALY —A monograph on the fossil Ostracoda of Italy has been begun by A Neviani The first part (*Mem Pont Accad Sci N Lincei*, Ser 2, vol 2) treats of those from the classical beds of Vallebiaja, near Faugha, which the author refers to the Lower Calabrian of Gignoux Nearly 70 species are described, about 18 being considered new, and the details of their occurrences in time from the Mesozoic to the present day are set forth in tabular form There is a good index and two excellent plates

THE BUSHVELD COMPLEX OF THE TRANSVAAL — Among the spectacular geological phenomena for which South Africa is becoming increasingly famous, the great body of igneous rocks known as the Bushveld complex occupies an impressive position Molengraaf, Mellor, Hall, Wagner, du Toit, and other pioneers have already established its principal

features, and now a valuable summary appears from the able pen of Prof R A Daly, accompanied by eighteen new analyses and a stimulating discussion of the kind which enlivens all his contributions to geological literature (*Bull Geol Soc America*, vol 39, pp 703 768 , 1928) This paper should be of special value to geologists attending the South Africa meet ing of the British Association and the meeting of the International Geological Congress Some of Daly's conclusions differ from the current interpretation of the Union Geological Survey According to the latter, the Bushveld felsite is excluded from the complex and assigned to a Rooiberg series which is made the top of the Transvaal system Daly thinks that the felsite is at least partly, and possibly wholly, a definite member of the complex, akin to the roof of the Duluth 'lopolith' which seems to have been in part its own extrusive phase, chilled against the atmosphere It is also suggested that the coarse granites of the Complex are not contemporaneous throughout, but are made up of two main intrusions, one red, pre ceding the norite, and the other pink and slightly more mafic, succeeding the norite It is recognised that the Complex will long furnish genetic problems of fundamental importance to geologists and petro logists In this paper the difficult questions of magmatic origins are touched on but lightly

LAPLAND METEOROLOGY — The observatory at Abisko, on Lake Torne in Swedish Lapland, has pub lished its detailed observations for both 1926 and 1927 The headings to the tables are in Swedish and French The usual meteorological data are given in full In addition, there are a number of valuable records on the hydrology of the lake, including its weekly tem perature at a depth of one metre, the dates of freezing and breaking up, and the thickness of the ice at weekly intervals during the long period from November to June, when the lake is frozen Soil temperatures, on every fifth day throughout the year, are given for depths of 50, 100, 150, and 200 cm There are also full notes on the displays of aurora borealis These publications are valuable contributions to the study of Arctic Europe

AUTOMATIC LEVEL GAUGE ALARM —The application of photoelectric and selenium cells to operate alarms and automatic controls regulating the level of liquid in tanks and stand pipes is an interesting example of the growing industrial application of these instruments The device is especially useful when the liquids are under high pressures, as then the standard methods of level control are inapplicable The following simple arrangement is in use at the works at Billingham of the Synthetic Ammonia and Nitrates Limited A glass in spection gauge is fitted at the required level on the stand pipe and the light sensitive relay is illuminated through the gauge Using opaque liquids, the light is shut off when the liquid rises and the relay then operates an alarm signal When transparent liquids are used, an opaque float in the gauge glass can be used to shut off the illumination when the liquid rises Alternatively, the light sensitive relay and the light source may be mounted on the same side of the gauge glass and the relay illuminated by a beam reflected by total internal reflection at the inner surface of the glass In this case reflection ceases when the liquid rises, the beam of light being refracted through the liquid The latter method is convenient when flat gauge glass, to which a right angle prism can be cemented, is used

PHOTOSYNTHESIS OF CARBOHYDRATES — Prof E C C Baly's production of carbohydrates by the exposure to light of carbonic acid which had been deposited on the surface of nickel or cobalt carbonate, of which an account was given in the *Proceedings of the Royal Society* for 1927, has now been shown by him and N R Hood to show an additional resemblance to natural processes in its susceptibility to the influence of temperature (*ibid*, A, vol 122, p 393, Feb 4) The yield of carbohydrates in his experiments increases linearly with temperature to a maximum at 31°, photosynthesis by some algæ has been long known to obey a similar law, and it is now found that the tem perature coefficients for the changes are almost the same in the two cases Above 31°, the yield again decreases in his experiments, and becomes almost zero at about 48°, a botanical analogue of this is known in the existence of an optimum temperature for natural photosynthesis by leaves, with an assimilation-temperature curve which is very similar to that found by Prof Baly, showing in particular a sharp peak at 37° Prof Baly has not discussed in any detail exactly what occurs in the purely physico chemical processes with which he had been concerned, but it is evident from the similarities that he has pointed out that many of the characteristics of the natural phenomena are merely those of a pure photochemical surface re action

TRANSMUTATION OF ELEMENTS —In an X ray tube there is a large localised dissipation of energy in the neighbourhood of the focus spot, where the electrons are incident on the anode If it were possible to bring about transmutation by moderate quantities of energy, conditions here would appear to be particu larly favourable, and any positive results obtained would carry considerable weight, since the substance being studied remains in a high vacuum throughout the experiment, and is thus not liable to chance contamination At the suggestion of Prof R A Millikan, tests of this nature have been made by L Thomassen in the Norman Bridge Laboratory at Pasadena His results, which are described in the February issue of the *Physical Review*, are completely negative no change was found in the characteristic X ray spectrum of a tungsten target before and after the tube holding it had been operated for three days at a peak potential of 207 kilovolts and a current of a few milliamperes The same author has also re peated the experiments of Prof Smits, from which it appeared at one time that lead might be transmuted into mercury, and has obtained no evidence of change in a lead arc, and inconclusive results with a high potential discharge between lead electrodes immersed in carbon disulphide, his conclusions in the latter case being similar to those afterwards arrived at by Prof Smits himself (see NATURE, Jan 2, 1926, p 13, and Oct 1, 1927, p 475)

PHOTOCHEMICAL DECOMPOSITION OF NITROGEN PENTOXIDE —The decomposition of nitrogen pent-oxide in the presence of the dioxide, which photo-sensitises the reaction, using monochromatic radiation of wave lengths 4350, 4050, and 3660 A, has been investigated by Baxter and Dickinson Their results, which are described in the *Journal of the American Chemical Society* for January, appear to follow the mechanism suggested by Norrish The first reaction is probably a decomposition of the dioxide into nitric oxide and oxygen This is followed by a dark re-action between nitric oxide and nitrogen pentoxide $NO + N_2O_5 = 3NO_2$ In the decomposition of nitrogen dioxide the quantum efficiency for radiation of wave length 4350 A is extremely low (0 0046 molecules of oxygen produced per quantum absorbed), and hence this wave length should be ineffective for the decom-position of the pentoxide This was actually found to be the case, since the effect with radiation 4350 A was too small to be detected with the apparatus used

The Eucalypts and Paper Pulp

THE paper pulp problem, especially with reference to what is termed newsprint or the material used by the daily press, is one of growing importance in many countries to those concerned At first sight it would not, however, have been considered by the average man in Great Britain that the question had become one of importance in Australia, yet it appears that, with an annual consumption of 120,000 tons of newsprint, Australia comes next to the United States of America and Canada on the basis of requirements per head of population. None of this paper is made in Australia, the reason given being that "existing processes of manufacture require light coloured coniferous wood that can be readily converted into pulp by purely mechanical means" This ground wood or mechanical pulp comprises 70 to 80 per cent of the fibre content of newsprint, the remainder being pulp from the same wood chemically prepared by the sulphite process and added to impart the necessary strength to the sheet

This being the position, the problem which has to be solved before newsprint can be manufactured in Australia is the discovery of a substitute for mechanical pulp that will compare with it favourably in the quality of the paper, as also in price The problem is no new one In India, investigations in connexion with various bamboos and grasses have been carried out at the Forest Research Institute for nearly a score of years past So far as quality goes, previous investigations in Australia (*Bulletin* No 25, Council for Scientific and Industrial Research Melbourne H J Green) have shown that it was possible to produce from the eucalypts bleached soda pulp much superior in quality to ground wood, and the indications were that on a large scale this pulp could be made at a cost not very much above the latter Experimental work in this matter had been carried out in connexion with the mountain ash (*E regnans*), Victoria, stringy bark (*E obliqua*), Tasmania gumtop (*E delegatensis*), Tasmania, beech (*Fagus Cunninghamii*), Tasmania, and *Pinus insignis* This work was, however, considered to be too incomplete to be worth publishing In connexion with *P insignis* it has been shown that it makes excellent sulphite pulp, as well grown *P insignis*, of 15 20 years of age, carry only about the same amount of resin as spruce

More detailed researches have since been undertaken by Messrs L R Benjamin and J L Somerville ("Paper Pulp and Cellulose from the Eucalypts by the Sulphite Process" *Bulletin* No 37, 1928) This bulletin deals with the research work carried out during the last four years on the problem of applying the sulphite process to the pulping of eucalypts from the practical viewpoint and bearing in mind the limitations imposed by existing industrial equipment The authors, in discussing their objective, remark

"The precedence in point of time accorded the soda pulping investigations was based entirely upon the fact that the so called 'hardwoods' are seldom pulped by any other than alkaline processes In this connexion it may be added that, by whichever process hardwood is pulped in other countries the product is almost invariably soft, bulky, and of low strength, its use being confined almost entirely to the manufacture of book papers in which the relatively high proportion of longer fibred sulphite pulp from soft wood is relied upon to impart the desired strength In other words, hardwood pulp is used abroad as a filler for imparting softness and opacity In *Bulletin* No 25, previously referred to, it was shown, however, that pulp of good colour and high strength could be obtained from the eucalypts by a suitable modification of the soda process, followed by proper bleaching and heating The experience thus gained has been of considerable value in the planning and conduct of the present investigation, one of the principal objects of which has been to find those cooking conditions that would give pulp possessing good strength and a colour sufficiently white, without bleaching, to be used, either alone or in high proportion, in the manufacture of newsprint Other aspects have also been considered, such as the production of high grade cellulose for use in the manufacture of artificial silk, but work in this direction has been restricted and mostly controlled by the necessity or desirability of acquiring evidence in support of certain trends, or of collecting incidental information that might be of value in establishing the proposed Australian newsprint industry"

The chemistry of the sulphite process, even at the present time, is incompletely understood, and there are many points connected with its application to the pulping of the eucalypts which the authors consider would well repay thorough investigation if the industry already existed in Australia, but they thought that for the present they should concentrate their investigations upon developing methods that would permit of ready application and be sufficiently economical to aid materially in the early establishment of the sulphite industry and the production of newsprint

Those interested in this matter should consult this very interesting and valuable monograph The authors' objects and results are expressed in the following

"Preliminary investigations with the sulphite process pointed to the possibility of cheapening production to the required degree, and subsequent systematic study of the process has practically assured this, for it is now evident that bleaching can be eliminated and a pulp produced so much superior in quality to mechanical pulp that the admixture of longer fibre for conversion into newsprint will probably not be necessary Hence, as far as the production of a suitable substitute for mechanical pulp is concerned, the results of the present investigation indicate that this is entirely feasible

"Apart from the demand for newsprint in this country, there is a large consumption of the better grade printing papers and writing papers in which high grade sulphite pulp is used In addition to this there is a very heavy and increasing demand for artificial silk both in yarn and in the form of piece goods These facts should stimulate the production of high grade bleached cellulose once a newsprint industry relying on sulphite pulp is established Accordingly, when it was found that the cooking conditions required for producing pulp sufficiently white in the unbleached state to be used in newsprint also closely approached those necessary for the production of high grade cellulose, the opportunity was taken of exploring the possibilities further As a result, considerable information on the physical qualities of the pulp, and the chemical purity of the cellulose produced in this investigation has been collected, and is now placed on record"

If this research work and experiments are translated into commercial operations, they should have an important outcome in the management of certain of the Australian forest areas Their study will also repay countries in which the Eucalyptus has been successfully grown in plantations

Natural History in Norfolk.

PROVINCIAL natural history societies may, and in many cases certainly do, perform very useful functions in keeping alive an active interest in Nature and the preservation of the local fauna and flora, but actual original work is generally confined to a small minority of members Indeed, it is one of the chief difficulties in keeping such societies alive that the active members bear so small a proportion to the whole A further difficulty exists when such societies also publish *Transactions* On one hand, such a publication must, if it is to justify itself, maintain a certain standard of interest and originality, on the other it is not advisable that it should be the medium of publication of original work of wide general interest, since the limited circulation of the journal makes it difficult of access, at all events in other countries The papers published should deal primarily with the natural history, in its widest sense, of the locality, so the series of volumes should form a mine of trustworthy local information

The Norfolk and Norwich Naturalists' Society has published its *Transactions* yearly, without a break, from its foundation in 1869, and has probably come as near as is possible to maintaining a general interest and value in its publications without going beyond its proper limitations The part just published (vol 12, part 4) opens with an account of the Mycetozoa by the president, Mr H J Howard, illustrated by some remarkably fine photomicrographs, and including a complete list of the Norfolk species Of the total of 121 species, Mr Howard has added sixty to the county list, and among these one new to Britain and two varietal forms new to science The paper should be of much value to anyone working at this group, by reason of the information given as to the nature of the habitat and season of appearance A paper on the Swan Marks of East Norfolk, illustrated by figures of 160 of these marks, by Mr Norman F Ticehurst, embodies the results of an enormous amount of patient research and is of much more than purely local interest

Prof F W Oliver writes with his usual charm of a visit to Holland for the purpose of seeing the progress of experiments in reclamation by means of *Spartina Townsendi* He has dealt with the subject in greater detail in other publications, but Norfolk has so much in common with Holland that what he has to say on this subject, and about the Nature reserves and flower culture in Holland, is of special interest to East Anglians

A paper on the survey of Scolt Head Island by Mr O D Kendall and Mr J A Steers is a continuation of work intended to record the progressive changes in sand dunes and shingle banks due to tide and wind, two maps and a section illustrate the results of the survey

Norfolk is fortunate in having the two National Trust properties of Blakeney Point and Scolt Head Island, both of which are being studied so effectively Blakeney Point has already become famous from the work done by Prof Oliver and his pupils, and at Scolt Head work on similar lines, under the supervision of Mr Steers, is producing results of wide and permanent interest The annual report of the Wild Birds Protection Fund again shows what excellent work in preservation of the local animal life can be done by provincial societies under the stimulus of an energetic personality The Norfolk Wild Birds Protection Committee owes its existence to Dr Long, and it is to him also that Norfolk owes the formation of the Norfolk Naturalists Trust, which owns a large area of marshes at Cley and intends to acquire other properties when the existence of rare birds seems likely *to be threatened* The report includes some remarkable records of ducks shot at Hickling and Ranworth, those for the latter going back to 1920 From these figures it seems that the numbers of wild fowl are not, as has been supposed by some, on the decline

The *Transactions* include also an article by Mr Stuart Baker on the scientific results to be obtained by egg collecting, and a paper by Mr Carruthers on planting at Scolt Head The latter is of general interest since much may be learnt from it as to the precautions to be taken in planting in such an exposed situation and on dunes

The Storage of Food

THE Report of the Food Investigation Board for 1927 [1] covers a wide range of problems connected with the subject of the storage of food, from purely scientific investigations to large scale experiments on food transport and the necessary engineering practice A considerable amount of work has been carried out on the transport and storage of fruit, especially apples, and on the changes taking place during storage which lead ultimately to its decay Ships' holds are not air tight, leaks occurring through hatches or wooden bulk heads between holds, from the low percentage of carbon dioxide frequently found, it appears that at least one third of the air present may be changed daily Well riveted steel bulkheads, however, allow of little leakage The question is of importance, both from the point of view of maintenance of a particular temperature in the hold, and also because the storage life of fruit depends in part on the composition of the surrounding air The conduction of heat from the ship into insulated holds along frames and beams projecting into the insulation, and the heat generated by the fruit itself in storage, have also to be taken into account in the design of refrigerators At 20° C sound apples generate heat at the rate of about 0 012 cal per sec per kgm, or 0 0015 cal per sec for an individual apple, in other words, an apple in 23 hours would raise the temperature of an equal weight of water 1° C if there were no heat loss In practice the temperature in the centre of the store is taken by means of a distance reading thermometer, of which a number of types have been studied

Numerous investigations have been carried out on the changes taking place in apples during storage and the factors influencing them It has been found that the smallest fruit have the lowest respiratory activity, and that the maximal rise in this activity is smaller and later than in larger apples at the same time, the smaller apples usually have the longest life A low respiratory activity therefore delays the onset of internal breakdown in storage The nature of the soil on which the fruit is grown has a definite effect on storage life apples off a heavy soil keep twice as long at 34° F as those off a light soil, whilst the keeping quality is also correlated with the 'available' potash and phosphoric acid in the soil The nitrogen content of different kinds of apples tends to remain fairly constant, a higher nitrogen content is associated with a

[1] Department of Scientific and Industrial Research Report of the Food Investigation Board for the year 1927 (London H M Stationery Office, 1928.) 4s net.

higher respiratory activity The amount of sucrose and acid present, however, varies considerably from one type to another, and is also affected by the nature of the season thus cold weather raises the acid content, at the same time decreasing the sucrose value, warm weather having the reverse effect By such changes season can alter the keeping qualities of the fruit, since life depends on the presence of respirable material During storage the sugar and acid disappear at a constant rate and breakdown occurs when the store of respirable material is exhausted Gas storage also delays breakdown by slowing the respiratory processes, but just before death there is a sudden increase in the utilisation of sugar

It has been found that the optimum temperature for gas storage is higher than that used for cold storage by gas storage is meant an increase in the carbon dioxide concentration above 5 per cent, with a corresponding decrease in the oxygen percentage Gas storage at a low temperature in fact accelerates internal breakdown, but at a temperature above about 40° F gas storage gives better results than cold storage alone In addition to the internal breakdown which occurs at low temperatures, appearing, however, only after six to ten weeks storage, there is another type of breakdown which is hastened by higher temperatures and occurs especially in imported apples it can be avoided by gathering the fruit before a certain critical stage of maturity on the tree has been reached and its onset is definitely delayed by cold storage

In addition to breakdown, fruit in store may be attacked by fungal disease the resistance of the fruit depends on a variety of factors, such as acidity water, nitrogen, and potassium content, and hence on the locality in which the fruit is grown A low water and nitrogen content and a high acidity and potash content are associated with a high resistance, the converse is also true

Another problem which has been investigated is the best method of bringing cold stored produce back to a normal temperature a rapid rise in air temperature leads to wetting of the fruit from condensation of water on its surface, since its temperature only rises slowly Two methods of preventing wetting are available a slow and uniform rise in temperature or drying of the air during warming which may be the better depends on knowledge of the rate of evaporation from the fruit to be warmed, a problem which requires further investigation under practical conditions

Further work has also been carried out during the year on meat and fish and their products The conditioning of beef hung at a temperature of 41° F has been studied there is a progressive increase in tenderness especially noticeable in the coarser joints or in inferior quality carcasses, and even after 17 days the meat is still perfectly sweet

It is now well known that, to obtain meat fit for consumption freezing should be rapid to avoid the formation of large ice crystals when the crystals are only small, on thawing the meat closely resembles fresh meat It has now been found that bacon can similarly be frozen and be edible on thawing again, but the temperature necessary is considerably lower than that required for meat or pork For pork, - 10° C may be sufficient, but for mild cured bacon, - 15° C at least is necessary for rapid freezing, the freezing point of the bacon being several degrees below that of pork The practicability of freezing bacon at - 15° C and then storing it at - 10° C is now being examined

Investigations of fish by products have included the nutritive value of fish meals and the use of fish skins as a substitute for isinglass It was found that seabream meal in the diet of pigs resulted in better growth than was given by the best white fish meal or blood meal and sterilised bone flour moreover, the growth was made at a smaller expense in food than in the case of ordinary fish meal, a fact of considerable commercial importance Similar results were obtained with rats, and the seabream meal also produced better calcification of the bones than white fish meal The seabream is an oily fish which is not much used for human consumption Work has also been carried out on the nature of the sterols in marine animals and on the constitution of squalene and certain of the higher alcohols, problems which may be found to have a bearing on the storage or use of the various products for human consumption

University and Educational Intelligence

CAMBRIDGE —The Council of the Senate has presented a report to the University on an offer by the Medical Research Council to equip a Nutritional Laboratory on a site at the Field Laboratories, and has recommended that the offer be gratefully accepted

LONDON —The University College Committee will award in June next a Bayliss Starling Memorial Scholarship of the value of about £120 (with exemption from tuition fees) Candidates may be graduates or undergraduates of approved standing in science or in medicine The Scholar will be required to follow a course of study approved by the Jodrell professor of physiology involving a training in the principles and methods of research in physiology and/or biochemistry Applications must be submitted on or before May 15, to the Secretary of University College, London (Gower Street, W C 1)

A movement has been for some time in progress to endow the chair of engineering at University College in order to commemorate the great and enduring influence of the late Sir Alexander Kennedy on engineering education This appeal has met with a wide response nearly £19,000 has been raised of the £30,000 required In a letter supporting the appeal, the presidents of the Royal Society and of the Institutions of Civil, Mechanical, and Electrical Engineers direct attention to Kennedy s pioneer work and the need of a permanent memorial Subscriptions may be sent to Lord Meston the Treasurer of this Fund, at University College

MANCHESTER —The University has received a bequest of £300 under the will of the late Miss Amy Henrietta Worswick In accordance with the wishes of the testatrix, the bequest will be devoted to the investigation of the causes and treatment of rheumatoid arthritis A temporary fellowship of the value of £150 per annum will be offered, and application may be made to the Registrar before Oct 15 next by any person who has obtained a medical qualification registrable in Great Britain

The University council has appointed Dr D R Hartree, lecturer in mathematical physics at the Cavendish Laboratory, to the Beyer chair of applied mathematics in succession to Prof E A Milne Dr Hartree was educated at Bedales School and at St John's College, Cambridge, of which he was an entrance scholar He took the Mathematical Tripos, Part I, in 1916, and the Natural Science Tripos, Part II (Physics), in 1922, his course being interrupted by the War With the rank of lieutenant, R N V R, he carried out research in ballistics and the calculation of high angle trajectories whilst in the Anti Aircraft Experimental Section of the Munitions Inventions Department He was elected to a fellowship of St John's College in 1922 and became a fellow of Christ's College in 1928

Calendar of Patent Records

March 17, 1693—During the seventeenth century there was a large number of patents granted in connexion with apparatus for working under water One such was granted to John Stapleton on Mar 17, 1693, for "a new engine soe by him contrived as to permitt a person inclosed in it to walk under water, and of a new invented way to force air into any depth of water to supply the person in the said engine therewith and for continuing a lamp burning under water, also a way to deserate and purifye the air so as to make the same serviceable for respiration" No further details of the apparatus are given

March 17, 1768—The art of making porcelain from native materials was unknown in England until William Cookworthy, chemist, of Bristol, discovered deposits of the requisite materials, kaolin and petuntse, in Cornwall and Devon Cookworthy was granted a patent for the manufacture on Mar 17, 1768, and established a factory at Plymouth, where the first china made of native clay was produced The patent was afterwards acquired by Richard Champion of Bristol, and was extended by Parliament

March 18, 1780—On Mar 18, 1780, there was granted to Louis Recordon, watchmaker, of London, the first patent for a self winding watch The re winding was effected by a heavily weighted but lightly balanced lever which was connected to the main spring spindle and was given sufficient motion to wind the spring by the ordinary movements of the wearer Breguet, the famous French watchmaker, made several watches with a similar device, and those that exist to day are said still to work satisfactorily

March 18, 1862—To Thomas Dunn, of Manchester, belongs the honour of having filed the largest patent specification This was lodged in connexion with his patent dated Mar 18, 1862, for "Improvements in the construction of bridges, roofs, houses, and other structures," and comprises 36 pages of description and 104 sheets of drawings It was printed at a total cost of more than £650, and formed a volume about 8 in thick which sold at the price of £2, 13s a copy The specification is very comprehensive, and includes the construction of bridges, reading rooms, floating fortifications, suspension roofs for railway stations, portable sheet metal buildings, churches, etc One of the most interesting proposals is the construction of elevated lattice work footbridges with spiral staircases which were especially designed to enable pedestrians to cross the busy streets of London, several examples of which are illustrated in the drawings Dunn was a prolific inventor, twenty three patents standing to his name in the printed indexes for improvements in machinery of all kinds

March 20, 1787—The practical application of machinery to the shearing of cloth, a necessary process preparatory to printing, is due to the Rev John Harmar, whose first patent for a cropping machine is dated Mar 20, 1787 In spite of a great deal of opposition the invention was extensively adopted, especially in the west of England, and was in use for many years

March 23, 1869—The synthesis of alizarin, the colouring matter of the root of the madder plant and the first of the natural dye stuffs to be produced artificially, was the work of Carl Liebermann and Carl Graebe of Berlin, who were granted a Prussian patent for five years for their invention on Mar 23, 1869 Commercial production of the synthetic alizarin was commenced the following year by the Badische Anilin und Sodafabrik by a process the English patent for which anticipated by one day an application from W H. Perkin for an identical process

Societies and Academies.

London

Royal Society, Mar 7—**T M Lowry and A G Nasini** The molecular dimensions of organic compounds Part 1 General considerations A comparative study of the physical properties of benzene with thiophen, toluene with a methylthiophen, benzene with cyclohexane, all pairs with similar boiling and freezing points, shows that the vapours exhibit regular increments rather than identity of properties, and the physical properties of the liquids and solids, depending on force fields of molecules as well as on dimensions, show still wider differences —**A G Nasini** The molecular dimensions of organic compounds Part 2 An apparatus, based on Rankine's method, has been constructed for measuring the viscosity of vapours, and Sutherland's constant and the mean collision area deduced for benzene and cyclohexane — Part 3 A further modification of the apparatus is described, in which a zero pressure is used on the condensation side of the capillary The viscosities of thiophen, methylthiophen and pyridine have been determined —**W A Bone and R P Frazer** A photographic investigation of flame movements in carbonic oxide-oxygen explosions A theoretical $2CO + O_2$ mixture is exploded at atmospheric pressure under varying conditions, such as 'dryness,' 'source and intensity of ignition,' as well as under the influence of superimposed 'shock waves' up to and including detonation The new Fraser high speed photographic machine was used Progressive drying reduces flame velocity and hinders combustion, but the hindering effect can be overcome by a strong electric field With superimposed 'shock waves' the speed at which a flame starts may be raised in successive abrupt steps until it attains a speed approaching that of the 'shock waves themselves'—**H S Patterson, R Whytlaw-Gray, and W Cawood** (1) Some observations on the condensation of water on smoke particles Particles of non hygroscopic smokes readily absorb water, thus increasing in size, if a small quantity of hydrogen chloride is present —(2) The process of coagulation in smokes Experimental graphs, especially for systems of low concentration, show distinct curvature in the direction indicated by theory Smokes which are most nearly homogeneous give coagulation graphs closely in agreement with Smoluchowski's theory as modified for aerial systems The smokes studied are formed by molecular collision rather than by condensation around pre existing nuclei —(3) The electrified particles in smokes A method has been worked out for counting directly charged and uncharged particles The particles of low temperature volatilisation smokes are initially almost entirely uncharged particles, but the proportion of charged particles rises rapidly Arc smokes and magnesium oxide smokes are highly charged from the start —(4) The structure of complex smoke particles Arc smokes often consist of aggregates of great complexity, composed of minute particles, while smokes produced by volatilisation at lower temperature have much simpler structure —**J G Semple** Cremona transformations of space of four dimensions by means of quadrics and the reverse transformations —**S Goldstein** On the vortex theory of screw propellers When the distribution of circulation along the blades of a screw propeller is such that, for a given thrust, the energy lost in the slip-stream is a minimum, then the flow far behind the propeller is the same as if the screw surface formed by the trailing vortices was rigid and moved backwards along its axis with a constant velocity —**O. W Richardson and P M Davidson** The spectrum of H_2: the

bands analogous to the parhelium line spectrum Part 2 The data give a spectroscopic ionisation potential of H_2 is 15 380 volts This compares with Pauli's value 23 7 volts on the old quantum mechanics and with 15 26 ± 0 13 estimated from Burrau's computations on the wave mechanics using Witmer's value of the heat of dissociation of H_2 —**R C Johnson** and **R K Asundi** A new band system of carbon monoxide Details are given of a new system corresponding to the transition $3'S \rightarrow 2'P$ —**I Waller** and **D R Hartree** On the intensity of total scattering of X rays General results due to Waller for radiation scattered by a many electron atom (neglecting 'relativity effects ') are used to give an approximate formula for intensity of total (coherent and incoherent) scattering of X rays —**C M White** Stream line flow through curved pipes A mathematical discussion indicating that for large disturbances, flow in curved pipes is more stable than flow in straight pipes, which is in opposition to the opinion that curvature tends to instability —**H A Wilson** The theory of cracking petroleum Calculations are based on theory of chemical equilibrium in mixtures of hydrocarbons discussed in previous papers When liquid fraction is greater than 50 per cent, calculated gasoline fraction is nearly independent of temperature and pressure, but depends on composition of oil When all oil is just vaporised the gasoline fraction is nearly the same in all cases Amount of oil cracked per day in a given reaction chamber at given temperature and pressure is inversely as gasoline fraction **A Fowler** The arc spectrum of silicon By passing an arc in nitrogen at atmospheric pressure, and using a vacuum spectrograph, the arc spectrum of silicon has been photographed to about λ1600 Comparison with singly ionised phosphorus, P II, shows the general similarity expected —**S F Grace** Internal friction in certain tidal currents —**T L Ibbs** and **A A Hirst** The thermal conductivity of gas mixtures —**D M Newitt, B J Byrne,** and **H W Strong** Equilibrium in the system methyl alcohol—hydrogen—carbonic oxide —**W A Bone, F R Weston,** and **D A Winter** Further experiments on the combustion of well dried carbon monoxide and oxygen mixtures Part 3 —**E K Rideal** and **O H Wansbrough-Jones** An investigation on the combustion of platinum —**R W Ditchburn** and **F L Arnot** The ionisation of potassium vapour —**H J Gough** and **H L Cox** The behaviour of a single crystal of zinc subjected to alternating torsional stresses —**F C Lea** The penetration of hydrogen into metal cathodes and its effect upon the tensile properties of the metals and resistance to repeated stresses —**W T Astbury** A new integrating photometer for X ray crystal reflections, etc —**T H Havelock** The dispersion of double refraction in quartz —**W L Bragg** The determination of parameters in crystal structures by means of Fourier series —**W G Bickley** Two dimensional potential problems concerning a single closed boundary —**P M S Blackett** On the design and use of a double camera for photographing artificial disintegration

Linnean Society, Feb 14 —**E E Edwards** On the morphology of the larva of *Dorcus parallelopipedus* L Apart from other characters, the larva of *Dorcus* can be separated from those of other European genera of Lucanidæ by the form and arrangement of the tubercles composing the coxæ and trochanteric stridulatory areas In its internal anatomy it exhibits affinities with certain genera of Scarabæidæ The nervous system is of an exceptionally primitive character as in *Lucanus*, and does not exhibit the great concentration of the ganglia of the ventral nerve cord prevalent in larvæ of the allied family Scarabæidæ —**A G Lowndes** Variation in Arctic freshwater Entomostraca Many species of freshwater Entomostraca are cosmopolitan in their distribution, and there appears to be no correlation between the difference in environments with variation shown by the separate species —**S R Bose** The biology of wood rotting fungi Viala's culture medium and sterilised wood blocks from which the air had been driven were used Sporophore formation occurred only in those cultures exposed to light, and was usually associated with poor vegetative growth When fruit bodies were formed, they usually occurred on the upper end of the slant towards the glass surface This is probably related to moisture conditions and the check of vegetative growth

CAMBRIDGE

Philosophical Society, Feb 11 —**T M Lowry** Configuration of quadrivalent atoms The evidence which led Werner in 1893 to assign a planar configuration to platinous salts of the type $[2NH_3 \; PtCl_2]$ is similar to that advanced by Vernon for tellurium and now disproved by Drew, who assigns to quadrivalent tellurium the same tetrahedral configuration as to sulphur X ray analysis however, has assigned a planar configuration to the anions of the tetragonal crystals of $K_2[PtCl_4]$, $K_2[PtCl_4]$ and $Am_2[PdCl_4]$ —**F G Mann** The stability of complex metallic salts αβγ Triamino propane co ordinates very firmly around the 6 co ordination octahedron, and in consequence divalent nickel, zinc, platinum and palladium all give salts containing the bis triaminopropane metallic complex $[\{NH_2 \; CH_2 \; CH(NH_2) \; CH_2 \; NH_2\}_2M]''$ Each metal has adopted the unusual (and in the case of divalent platinum, and palladium, quite abnormal) co ordination number of 6 in order to provide the octahedron necessary for maximum stability of the completed complex salt This accounts for their unexpected stability —**F H Constable** An apparatus for the study of gas reactions on electrically heated films of known area Electrodeposition on a graphite foundation, from a moving electrolyte, is used to produce metallic films The area is found by the interference method Carbon films are produced on graphite by the thermal decomposition of hydrocarbons While the area of a particular carbon film by the methylene blue adsorption method appears to be 6 8 times the plane area the area from sections drawn to scale showing irregularities greater than 5×10^{-4} cm is of the order of twice the apparent area **C P Snow** The structure of the nitric oxide molecule The vibration and rotation spectrum of nitric oxide has been studied upon a large infra red spectrometer specially designed for the analysis of bands into fine structure There is found to be one vibration band

PARIS

Academy of Sciences, Feb 4 —**Georges Claude** The utilisation of the thermal energy of the sea The experimental plant successfully operated last year at Ougrée is to be transferred to Cuba It is arranged to work on the difference of temperature between the temperature of the water at sea level and that at a depth of about 600 metres The tube will be two metres in diameter and two kilometres in length —**T A Janczewski** Theorems of oscillation for differential systems of the fourth order —**R Wavre** The problem of the figures of equilibrium of a fluid heterogeneous mass —**Joseph Pérès** The actions of a viscous fluid on an obstacle The case of the ellipsoid —**P Noaillon** Sketch of a new theory of the resistance of fluids —**Henri Malet** The propagation of light in the ether —**L Mallet** The ultra violet radiation of substances submitted to the gamma rays When pure liquids, such as water, are submitted

to the gamma high frequency radiation, light is emitted The continuous spectrum of this light appears to be limited by the natural absorption of the excited liquid —**Pierre Auger** The influence of the level of origin of the photoelectrons on the distribution in space of their initial directions —**A Boutaric** Remarks on the formulæ representing adsorption isotherms A comparison of tho formula of Freundlich and that of Jean Perrin —**Pierre Jolibois and Louis Chassevent** The reactions between colloidal silica and lime The reactions between silica and lime in solution are due to three phenomena, the coagulation of the silica by the lime, the combination of the lime and silica giving a hydrated calcium silicate, followed by adsorption of the lime In solutions rich in lime this adsorption continues for months —**R Bureau** The experimental study of the zones of silence in the propagation of short [wireless] waves As a provisional explanation, which further data may cause to be modified, it is suggested that the ionised layers of the upper atmosphere play the principal part but in certain critical cases a very slight modification may decide between two different paths through the ionised layers —**M and Mme A Chauchard** The influence of ischemia on the excitability of the cerebral cortex —**Maurice Fontaine** The increase in the consumption of oxygen by marine animals under the influence of high pressures Its variations as a function of intensity of compression —**Raymond-Hamet** The glucosides of *Digitalis purpurea* After a summary of the results obtained by various workers on the toxicity of commercial preparations from digitalis, an account is given of the direct comparison of the toxicity of crystallised digitaline (Nativelle) and pure digitoxine (Clœtta) From experiments on 120 dogs, the physiological activity of these two products was found to be identical —**Maurice Piettre** Some properties of serum albumen its crystallisation in the absence of any ionogenic element The application of tho acotone method, which permits tho analytical separation of the proteins and their preparation in the pure state, has solved the problem of the crystallisation of albumen, without any ionogenic element being present —**Marage** The choice of an ear trumpet —**Georges Blanc, J Caminopetros, J Dumas, and A Saenz** Experimental researches on the sensibility of the lower apes to the virus of dengue Various species were inoculated with the blood of men suffering from dengue None of the animals showed any clinical signs of the disease and there was no rise of temperature, but their blood, which was non virulent twenty four hours after inoculation, became virulent between the fifth and eighth days The apes thus treated were immune for at least fifty days

COPENHAGEN

Royal Danish Academy of Science and Letters, Oct 10 —**Niels Bohr** Quantum theory and relativity An examination of the difficulties brought to light by the attempts at reconciliation of the quantum postulate with the idea of relativity seems to require a further revision of our fundamental physical concepts as regards their application to atomic phenomena

Nov 2 —**Ejnar Hertzsprung** Proper motions of faint stars in the Pleiades Provisional results of an investigation in progress Comparison of old and new plates of the Pleiades taken at different observatories mainly in order to pick out the faint physical members of the group by aid of their common proper motion —**August Krogh** The biological assay of insulin After mentioning the degree of purity attainable in insulin preparations which is ascertainable by chemical assay, a comparison is given of biological methods

Nov 16 —**J N Brønsted** The kinetics of ethylene oxides The apparent basicity of ethylene oxides is explained on the basis of kinetic measurements in aqueous solutions of various composition It has been possible by these measurements to verify tho conclusions of recent theories on reaction velocity The results obtained have also some bearing upon the general problem of the nature of acids and bases

ROME

Royal National Academy of the Lincei, Nov 18 —**Gino Fano** Birational contact transformations of the plane —**U Cisotti** Concerning two recent notes by M Pascal and C Ferrari —**U Cisotti** Hydrodynamic actions in the proximity of salients —**A L Herrera** Investigations on the imitation of organised forms with albumen and mineral acids (2) Further structures resembling those of unicellar organisms or of cellular tissues are described The forms obtained exhibit no evolution or motion, they may be stained with hæmotoxylin and preserved in glycerol —**R Calapso** A transformation of the surface R —**R Caccioppoli** The expression of the area of a surface by means of a doublo integral —**Silvia Martis in Biddau** Calculation of the logarithm of a matrix of the second order, and its application to the study of groups of one parameter containing a given substitution —**V Glivenko** The probable values of functions —**E Cech** Asymptotic correspondences between two surfaces —**E Pistolesi** Further with regard to the Kutta Joukowski theorem in the case of the plane strip —**G Viola** Elliptical elements of the system of U Ophiuchi —**A Carrelli** The theory of sensitised fluorescence A treatment is given of the phenomenon of sensitised fluorescence on the basis of undulatory mechanics, the method followed being that by which Born elaborated the theory of inelastic shock between the electron and the material atom —**V Polara** Gibbs theorem (phase rule) for heterogeneous equilibria —**G Bargellini** 2 6 Dichlorophenetidine The results of earlier experiments indicated that the dichlorophenetidine prepared by Jaeger by passing hydrogen chloride through an alcoholic solution of p nitrosophenol is probably the 3 5, but possibly the 2 6 compound The latter has now been prepared in another way and proves to be different from Jaeger's compound, which is therefore 3 5 dichlorophenetidine —**G Mezzadroli and E Vareton** Influence of metallic magnesium on the formation of formaldehyde and sugars by the action of ultra violet rays on solutions of calcium bicarbonate The reducing power (towards iodine solution) developed on exposing calcium bicarbonate solutions to ultra violet rays attains a maximum after 30 minutes if open basins, or after an hour, if closed vessels of transparent quartz are used, the yield of reducing substances is higher in the latter case The presence of metallic magnesium in the solutions increases the total quantity of reducing substances formed, and induces the formation of sugars capable of reducing Fehling's solution and of giving an osazone —**G Spagnol** Experiments on the fixation of colloids caused by chloroform If colloidal mercuric sulphide is injected into the auricular vein of a rabbit and a wad of cotton wool soaked in chloroform is simultaneously applied for 15 seconds to the animal's side, a sharp black stain of the sulphide is found in the subcutaneous connective tissue under the chloroformed spot when the rabbit is killed—after 2 hours or 8 days Similar fixation of Trypan blue is observed —**A Desio** Presence of the miocene in Sirtica —**G Brunelli** The epoch of reproduction of *Delphinus* —**M Tirelli** Studies on the physiology of insects (nervous system) —**A Barchiesi** Histophysiological investigations on the influence of variations of temperature in certain organs of heterotherms

Official Publications Received

BRITISH.

Memoirs of the Geological Survey of India. Vol. 53 The Structure and Correlation of the Simla Rocks. By Dr Guy E Pilgrim Pp vi+140+xix (Calcutta Government of India Central Publication Branch) 4 rupees, 6s 9d.

Journal of the Indian Institute of Science Vol 11A Part 16 I a Isopropylglutaconic Acid by K V Hariharan K N Menon and J L Simonsen II Derivatives of Methyl 2 2 Dimethylcyclopentan 3-one 1 Carboxylate by C S. Gibson K V Hariharan and J L. Simonsen. Pp 207 220. 12 annas. Vol 11A, Part 17 I Thiophthalic Acids Part I by Gopal Chandra Chakravarti II Organic Cyclic Polysulphides Condensation of Ethylene Mercaptan with Di and Trichloracetic Acids, by Gopal Chandra Chakravarti and Jogendra Mohan Saha Pp. 221 230. 8 annas Vol 11A, Part 18 Bio-Semidine Inversion in Aromatic Dihydrazo Compounds By Praphulla Chandra Guha and Hirendra Kumar Banerjee Pp 231 239 8 annas. (Bangalore)

FOREIGN.

Appendix No 2 to Annual Report of the Chief of the Bureau of Navigation, 1928 Annual Report of the Naval Observatory for the Fiscal Year 1928 Pp. iii+38 (Washington D C Government Printing Office)

Department of the Interior Bureau of Education Bulletin 1928 No 18 Private and Endowed Schools offering Trade and Industrial Courses By Maris M Proffitt Pp iii+50 (Washington, D C Government Printing Office)

Statens Meteorologisk Hydrografiska Anstalt. Årsbok 8 1926 III Vattenstånden vid rikets kuster Pp 21 2 00 kr Årsbok 9 1927 V Hydrografiska mätningar i Sverige Pp 25+4 plates 5 00 Kr (Stockholm)

Memoirs of the College of Science Kyoto Imperial University Series A, Vol 11 No 6 Pp 451 551+10 (Kyoto.)

State of Connecticut State Geological and Natural History Survey Bulletin No 43 The Life Forms of Connecticut Plants and their Significance in relation to Climate By Dr Beulah Ennis. (Public Document No 47) Pp 100+20 plates+v (Hartford Conn)

Diary of Societies

FRIDAY, MARCH 15

ASSOCIATION OF ECONOMIC BIOLOGISTS (in Botanical Lecture Theatre Imperial College of Science and Technology) at 2.30 —Sir John Russell Some Agricultural Problems in Australia.—F L. McDougall The Commonwealth Council of Science and Industry in its Relation to Agriculture

ROYAL ASTRONOMICAL SOCIETY (Geophysical Discussion), at 4 30.—Thunderstorms and the Maintenance of the Earth s Electric Field Chairman, Prof S Chapman Discussion to be opened by Prof E V Appleton and continued by R. A. Watson Watt Dr G C Simpson Prof C T R Wilson, and T W Wormell

BIOCHEMICAL SOCIETY (Annual General Meeting) (in Department of Physiology and Biochemistry University College), at 4 30 —I S MacLean Further Observations on the Sterols of Yeast.—H J Channon and A C Chibnall The Isolation of n nonacosane and di n tetradecyl Ketone from Cabbage Fat —J G Davis and A T R. Mattick The Metabolism of a Pigmenting Anaerobic Bacterium —G N Richardson and R K. Cannan Reaction of Azine Compounds with Proteolytic Enzymes —B C Guha and Prof J C Drummond Observations on the Concentration of Vitamin B_1 —Prof J C Drummond R. A. Morton, and K H Coward A Critical Examination of the Methods for the Assay of Vitamin A.—C R Harington and S S. Randall Isolation of 3 5-diiodotyrosine from the Thyroid Gland

MEDICAL OFFICERS OF SCHOOLS ASSOCIATION (Annual General Meeting) (at Society of Medical Officers of Health, 1 Upper Montague Street) at 5 —Sir Henry Gauvain The Combined Education of Children Suffering from Physical Defects

BRITISH INSTITUTE OF RADIOLOGY (Medical Meeting), at 5 —Discussion on Urinary Cases

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5 —Sir Arthur Keith Demonstration of Recent Advances in our Knowledge of the Anatomy and Physiology of the Gall Bladder

BRITISH PSYCHOLOGICAL SOCIETY (Æsthetics Section) (at Bedford College), at 5 30 — Mrs. Roberts (Susan Miles) and others Discussion on Inspiration.

SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (Annual Meeting) (at Liverpool University), at 6.—L. O Newton Boiler Feed Water

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—F C Johansen Research in Mechanical Engineering by Small Scale Apparatus.

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Newcastle-upon Tyne), at 6.—J H. Gibson Mechanical and Transmission Losses in Marine Engines Shafting, and Propellers.

INSTITUTION OF ELECTRICAL ENGINEERS (London Students Section), at 6.15 —C F J Morgan Wave form Analysis.

ROYAL AERONAUTICAL SOCIETY (at 7 Albemarle Street), at 6.30 —L. T Brown The Napier Lion Engine

SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) (at Glasgow), at 6 45 —Annual Meeting

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (Annual General Meeting) (at Cardiff Technical College), at 7 —T G Watts The Co-ordination of Chemical Industry and Chemical Societies.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group) at 7

SOCIETY OF DYERS AND COLOURISTS (Glasgow Section) (at 7 Gordon Street, Glasgow), at 7 15 —F Asquith The Necessity of Application of Fast Colours on Textile Fabrics.

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7 30—T Grime Locomotive Rating

ROYAL SANITARY INSTITUTE (at Town Hall, Torquay), at 8 —G J Loveless The Plumber and Public Health

ROYAL SOCIETY OF MEDICINE (Obstetrics Section) (jointly with Maternity and Child Welfare Group of the Society of Medical Officers of Health), at 8 —Discussion on The Future of the Maternity Services —Openers for Section of Obstetrics Prof J M M Kerr and E. Holland.—Openers for Society of Medical Officers of Health Dr E Hill and Dr J J Buchan

ROYAL SOCIETY OF MEDICINE (Electro-Therapeutics Section), at 8 30 — Dr W S Whitcombe Intensive Ionisation —Dr A B MacLean The Prone Position as a Routine Method in the X ray Examination of the Stomach, with a Note on the Question of Retractability of the Stomach.

ROYAL INSTITUTION OF GREAT BRITAIN at 9 —Prof V M Goldschmidt The Distribution of the Chemical Elements.

SOCIETY OF DYERS AND COLOURISTS (Manchester Section) — Short Papers

SATURDAY MARCH 16

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (South Midland District) (at Uxbridge), at 10 30 A M

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (South Western District) (at Guildhall Bath), at 11 A M —Annual District Meeting

BRITISH MYCOLOGICAL SOCIETY (at University College), at 11 —C R. Metcalfe Shab Disease of Lavender —Dr G H Pethybridge Exhibit of an Unusual Hypertrophy in Potato Tubers due to *Spongospora*.—Miss K Sampson Some Observations on *Epichloe typhina* (Pers) Tul —R. S. Vasudeva On the Parasitic Invasion of Apple Fruit by Various Fungi —W R D Weston The Relative Resistance of some Wheat Varieties to *Tilletia caries* (DC) Tul (T Tritici Wint)

PHYSIOLOGICAL SOCIETY (Annual General Meeting) (at University College), at 3 —M C G Israels and F W Lamb Carbon Dioxide Equilibria between Mixed Venous Blood and Rebreathed Airs —Dr J S Haldane Claude Bernard s Conception of the Internal Environment.—A Hemingway and J M Peterson The Action of Oxytocin and Vasopressin on the Perfused Isolated Kidney —Prof R. S S McDowall The Central Chemical Control of the Heart Rate —A I Gorer and M S Pembrey Observations upon the Respiratory Exchange of Hibernating Mammals —R. E Havard and I M T Kerridge A Change in the Hydrogen Ion Concentration of Blood after Shedding —Ruth Deansley The Effect of Toxins on the Adrenal Gland —G F Marrian The Assay of Œstrin —A. R Fee and Dr A S Parkes The Mechanism of Ovulation in the Rabbit.—A R Fee Experimental Water Diuresis —A R Fee and E Ogden Physiological Significance of the Renal Portal System —E Leyko The Action of some Heart Tonics —E Leyko and J Mehes The Action of Ephedrine —J P Bouckaert Efficiency and Fenn Effect in Tortoise Muscles —J P Bouckaert F Cappellen and J De Blende Value and Significance of the Constants of Muscle Viscosity —H Florey A. Szent-Gyorgyi and M E Florey Methods for Testing for the Presence of Adrenal Cortex Hormone —M Grace Eggleton and Prof C Lovatt Evans The Formation and Disappearance of Lactic Acid —Demonstrations —M C G Israels and F W Lamb A Modified Henderson Automatic Sampler for Alveolar Air — F W H Ellis (a) A Water Driven Centrifuge (b) Variable Speed Gear (c) Artificial Lung with Bakerlite Plates (Bayliss Fee and Ogden) (d) A Perfusion Tap (e) Perfected Roller Pump (Bayliss).— G E S Ward and S Wright Human Electrocardiographic Curves During and After Nitrous Oxide Anæsthesia.—Dr B A McSwiney A Frog s Heart Chamber —A. R. Fee and Dr A S. Parkes The Effect of Hypophysectomy (by Decerebration) on Ovulation in the Rabbit — J P Bouckaert Apparatus for Measuring Muscle Viscosity Extension time Curve —F Gairns Microscopic Demonstration of Nerve Endings —Prof A V Hill The Increment due to Stimulation in the Resting Anaerobic Heat-Rate of Muscle —R I Lythgoe (a) Test Types (b) Apparatus for Study of Visual Acuity (Mezzanine)—W S. Duke Elder P M Duke Elder and J Colle The Optical Registration of the Intra ocular Pressure —E Bozler The Heat Production of Smooth Muscle —F R. Winton A Thermostat Constant to One thousandth of a Degree Centigrade at Body Temperature

ROYAL INSTITUTION OF GREAT BRITAIN at 3 —Sir Ernest Rutherford Molecular Motions in Rarefied Gases (III)

GEOLOGISTS ASSOCIATION (North East Lancashire Group) (at Blackburn Technical College) at 7 —J Ranson The Evolution of the Craven Highland

HULL ASSOCIATION OF ENGINEERS (at Technical College Hull) at 7 15 — G E Petty Aeroplane Design

MONDAY MARCH 18

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4 30 —Rev A H Finn Conjectural Emendations in the Psalms

ROYAL COLLEGE OF SURGEONS OF ENGLAND at 5 —C E Shattock Demonstration of Specimens Illustrating Diseases of the Testis

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6 30.— M Isacco The Helicogyre.

INSTITUTION OF MECHANICAL ENGINEERS (Graduates Section London), at 6 30 —K Brinsmead Locomotive Lubrication

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7 —C Turnbull and others Discussion on Method in Invention

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (at Liverpool University), at 7 —E Y Robinson Radio Sets on the Mains.

BRADFORD TEXTILE SOCIETY (at Midland Hotel Bradford), at 7 30 — W Bell Banking and Commerce

HUDDERSFIELD TEXTILE SOCIETY (at Huddersfield Technical College) at 7 30 —H Wilkinson The Practical Routine of Piece Dyeing

SOCIETY OF CHEMICAL INDUSTRY AND INSTITUTE OF CHEMISTRY (Edinburgh and East of Scotland Sections) (at 36 York Place Edinburgh), at 8 — J A Reavell Heat Transmission

CHEMICAL INDUSTRY CLUB, at 8.—Dr C Singer Hygiene and History

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30 —O G S Crawford Air Photographs of the Middle East

TUESDAY, MARCH 19

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5 —Dr R. A Young A Medical Review of the Surgery of the Chest (Lumleian Lectures) (I).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5 15 —Dr S. W Kemp Antarctic Whaling Expeditions (II).

Mineralogical Society, at 5.30.—A. W. Groves and A. E. Mourant: Inclusions in the Apatites of some Igneous Rocks.—L. A. Narayana Iyer: Calc-gneisses and Cordierite-sillimanite gneisses of Coimbatore, Madras Pres., and of Similar Occurrences in India.—F. A. Bannister: A Relation between the Density and Refractive Index of Silicate Glasses with Application to the Determination of Imitation Gem-stones.

Royal Society of Medicine (General Meeting), at 5.30.

Zoological Society of London, at 5.30.—Dr. C. J. Van der Klaauw: On the Development of the Tympanic Region of the Skull of the Macroscelididæ.—Lilian Russell: The Comparative Morphology of the Elysioid and Æolidioid Types of the Molluscan Nervous System and its Bearing on the Relationships of the Ascoglossan Nudibranchs.—S. Maulik: On the Structure of the Hind Femur of Halticine Beetles.—J. W. Winterbottom: Studies in Sexual Phenomena—Communal Display in Birds.—Capt. C. R. S. Pitman: Notes on the Vertebrate Fauna of Nkosi Island, Lake Victoria, Uganda, Africa.

Institution of Civil Engineers, at 6.

Institution of Electrical Engineers (South Midland Centre) (jointly with East Midland Sub-Centre) (at Loughborough Town Hall), at 6.45.—H. B. Atkinson: How Electricity does Things (Faraday Lecture).

Electrical Association for Women (at 15 Savoy Street), at 7.—H. Bourne: Some Elementary Facts concerning Electric Motors.

Institution of Electrical Engineers (North Western Centre) (at Engineers' Club, Manchester), at 7.—T. N. Riley and T. R. Scott: Electrical Insulating Papers for the Manufacture of Power Cables.—S. G. Brown and P. A. Sporing: The Prevention of Ionisation in Impregnated Paper Dielectrics.

Institution of Heating and Ventilating Engineers (Associate Members and Graduates Branch) (at Milton Hall, Manchester), at 7.—A. E. Cubbage: Address.

Illuminating Engineering Society (at 15 Savoy Street), at 7.—W. Maitland: Architectural Lighting.

Royal Photographic Society of Great Britain (Kinematograph Group), at 7.—E. E. Lamb: Demonstration of Bell and Howell Kinematograph Cameras and Projectors.—B. W. Hanchett: A New System of Studio Lighting for Panchromatic Film, with Mercury Vapour Lamps.

Institute of Metals (Birmingham Local Section) (at Engineers' Club, Birmingham), at 7.—Dr. N. F. Budgen: Aluminium.

Institute of Metals (North East Coast Local Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.30.—Annual General Meeting and Exhibition.

Institution of Automobile Engineers (Inventors' Evening) (at 83 Pall Mall), at 7.45.

Manchester Athenæum Textile Society (at Manchester).—H. P. Curtis: Cloth Faults.

WEDNESDAY, March 20

Institution of Naval Architects (Annual Meeting) (at Royal Society of Arts), at 11.—Admiral of the Fleet Lord Wester Wemyss: Presidential Address.—Sir William J. Berry: H.M. Battleships *Nelson* and *Rodney*.—Lieut.-Col. F. Doudoni: Sea Trials of Italian Destroyers.

Institution of Chemical Engineers (Annual Corporate Meeting) (at Grosvenor House, Park Lane), at 12.15.—Sir Alexander Gibb: The Co-ordination of Engineering Institutions and Societies (Presidential Address).—At 2.15.—Prof. B. P. Haigh: Chemical Action in Relation to Fatigue in Metals.

Society of Glass Technology (at Leeds University), at 2.30.

Geological Society of London, at 5.30.—Sir Douglas Mawson: Some South Australian Algal Limestones in Process of Formation.—Dr. A. W. Groves: The Unroofing of the Dartmoor Granite and an Outline of the Distribution of the Detritus in the Sediments of Southern England.

Institution of Electrical Engineers (Tees-Side Sub-Centre) (at Cleveland Technical Institute, Middlesbrough), at 7.—R. W. Gregory: Electric Supply to the Rural Districts of England.

Textile Institute (London Section), at 7.—H. Clayton and others: Informal Discussion on Fabric Printing.

Institution of Electrical Engineers (Sheffield Sub-Centre) (in Mappin Hall, Sheffield), at 7.30.—Prof. W. Cramp: The Cause and Effect of Oscillation in Electrical and Mechanical Apparatus.

Royal Meteorological Society, at 7.30.—R. A. Watson Watt: Weather and Wireless (G. J. Symons Memorial Lecture).

Royal Microscopical Society, at 7.30.—Capt. M. A. Ainslie, C. Beck, J. W. Gordon, Sir Herbert Jackson, Prof. A. W. Porter, and J. Rheinberg: Discussion on paper by Dr. H. Moore on The Mode of Formation of the Image in the Microscope.

Royal Society of Arts, at 8.—Prof. A. E. Richardson: Modern English Architecture.

Entomological Society of London, at 8.

Royal Society of Medicine, at 9.15.—Dr. I. Williams: Napoleon III.

THURSDAY, March 21

Institution of Naval Architects (Annual Meeting) (at Royal Society of Arts), at 11.—J. Johnson: The Propulsion of Ships by Modern Steam Machinery.—Dr. J. Bruhn: Some Considerations Regarding International Loadline Regulations.—At 3.—Dr. G. Kempf: New Results Obtained in Measuring Frictional Resistance.—C. F. A. Fyfe: The Practical Use of the First British Built Bauer-Wach Exhaust Steam Turbine Installation in the Booth Liner *Boniface*.—At 8 P.M.—Prof. C. E. Inglis: Natural Frequencies and Modes of Vibration in Beams of Non-Uniform Mass and Section.—S. A. Hodges: The Behaviour of Stiffened Thin Plating under Water Pressure.

Chemical Society (Annual General Meeting) (at Leeds University), at 4.30.—Prof. J. F. Thorpe: Co-operation in Science and Industry (Presidential Address).

Royal Society of Medicine (Dermatology and Epidemiology Sections), at 4.45.—Special Discussion: Industrial Dermatoses, their Causation, Recognition, Prevention, and Treatment.

Royal College of Physicians of London, at 5.—Dr. R. A. Young: A Medical Review of the Surgery of the Chest (Lumleian Lectures) (II.).

Royal Institution of Great Britain, at 5.15.—Rev. W. H. Draper: Change of Meaning of Words from One Period to Another.

Institution of Mining and Metallurgy (at Geological Society), at 5.30.

Institution of Electrical Engineers, at 6.—Hon. Sir Charles A. Parsons and J. Rosen: Direct Generation of Alternating Currents at High Voltages.—J. A. Kuyser: Recent Developments in Turbo-Generators.

Institution of the Rubber Industry (Manchester and District Section) (at St. Mary's Parsonage, Manchester), at 7.—Dr. G. Barr: Ageing of Cotton contained in Rubber Goods.

Institution of Automobile Engineers (Western Centre) (at Technical School, Gloucester), at 7.30.—L. W. Johnson: The Inspection of Metals and their Alloys.

Batley and District Textile Society (at Public Library, Batley), at 7.30.—J. Brooke: Practical Hints on Carding.

Royal Society of Tropical Medicine and Hygiene (Laboratory Meeting) (at Royal Army Medical College), at 8.15.—Demonstrations by Dr. Mary Andrews, Major E. E. Austen, Major H. C. Brown, Dr. W. T. C. Broom, Major S. Elliott, Dr. E. Hindle, Dr. A. C. Stevenson, Col. S. P. James, Col. W. P. MacArthur, Dr. J. C. Ray, Major D. T. Richardson, and Dr. V. B. Wigglesworth.

Royal Society of Medicine (Urology, Pathology, and Therapeutics Sections), at 8.30.—Special Discussion: Urinary Antiseptics.

FRIDAY, March 22

Institution of Naval Architects (Annual Meeting) (at Royal Society of Arts), at 11.—Eng. Rear-Admiral W. Scott-Hill: Powdered Coal for Ships.—A. Spyer: Modern Developments of the Water Tube Boiler for Marine Purposes.—Eng. Rear-Admiral A. E. Hyne: Suggested Modifications to Marine Water Tube Boilers.—At 3.—J. Rennie Barnett: Motor Life-Boats of the Royal National Life-Boat Institution.

Textile Institute (Lancashire Section) (at Manchester), at 1.15.—J. W. Cooling: Air Conditioning Apparatus including Humidifying and De-Humidifying.

Royal Society of Medicine (Disease in Children Section) (Clinical Meeting at Royal Free Hospital), at 4.30.

Physical Society (Annual General Meeting) (at Imperial College of Science), at 5.—Dr. W. H. Eccles: Presidential Address.

Royal College of Surgeons of England, at 5.—Sir Arthur Keith: Demonstration on the Nerve Supply and Movements of the Colon.

Institute of Marine Engineers, at 6.30.—Annual General Meeting.

Institution of Locomotive Engineers (North Eastern Centre) (at Hotel Metropole, Leeds), at 7.—T. Robson: Experiments on Buffer Springs.

Royal Photographic Society of Great Britain, at 7.—H. Lambert: Warm Tones on Chloro-Bromide Papers.

West of Scotland Iron and Steel Institute (Annual General Meeting) (at Royal Technical College, Glasgow), at 7.—F. G. Martin: Elastic Limit Steel.

Blackburn Textile Society (at Blackburn Technical College), at 7.30.—A. J. Hall: The Dyeing and Finishing of Cotton Piece Goods containing Artificial Silk.

Leicester Textile Society (at Victoria Hall, Leicester), at 7.30.—S. Kershaw: Faults in Yarns.

Junior Institution of Engineers (Informal Meeting), at 7.30.—D. A. Collin: Ventilation.

Royal Institution of Great Britain, at 9.—Sir Ernest Rutherford: Penetrating Radiations.

SATURDAY, March 23

Royal Institution of Great Britain, at 3.—Sir Ernest Rutherford: Molecular Motions in Rarefied Gases (IV.).

PUBLIC LECTURES

SATURDAY, March 16

Horniman Museum (Forest Hill), at 3.30.—J. R. S. Dallas: Saxon Churches and their Remnants.

MONDAY, March 18

East Anglian Institute of Agriculture (Chelmsford), at 7.—W. R. Dunlop: The Economy of Labour in Farming.

TUESDAY, March 19

Bedford College, at 5.15.—Sir Herbert Baker: Modern Tendencies in Architecture.

SATURDAY, March 23

Horniman Museum (Forest Hill), at 3.30.—M. A. Phillips: Mammals of Britain.

DISCUSSION

Friday, March 15

Faraday Society (at Chemical Society), at 2.30 and 4.30 (*continued from March* 14).—Crystal Structure and Chemical Constitution:—

Part II. Organic Compounds.—Sir William Bragg: Introduction.—Dr. A. Müller: A Hydrocarbon Model.—Dr. H. S. Piper: Limitations in the Method of Identifying Long Chain Compounds by a Measurement of their Spacings.—Mrs. K. Lonsdale: X-ray Evidence on the Structure of the Benzene Nucleus.

Part III. Metals.—Dr. J. D. Bernal: The Problem of the Metallic State.—Prof. A. F. Westgren and G. Phragmén: X-ray Studies on Alloys.

Part IV. General.—Prof. A. Reis: On the Intensity, Sharpness, and Reducibility of the Debye-Scheerer Lines.—Prof. H. Mark: The Methods of Determining the Size and Shape of Small Crystals.—Dr. K. Weissenberg: Lattice Determination in Polycrystalline Aggregates.—Dr. W. T. Astbury: An Integrating Photometer for X-ray Crystal Reflections.—Dr. N. H. Kolkmeijer: Allotropy and the Determination of Densities by X-rays.—Prof. P. P. Ewald: Report on Recent Developments of Wave Mechanics and its Bearing on Crystal Structure.

SATURDAY, MARCH 23, 1929.

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Editorial and Publishing Offices

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No 3099, VOL 123]

The National Museums at South Kensington

WE dealt last week with the position of the Natural History Museum at South Kensington in relation to the Trustees of the British Museum at Bloomsbury, of which it is a branch There are eventually to be three museums at South Kensington, and it seems to be desirable that these should be under a single authority interested in the advancement of natural knowledge and its utilisation for the good of the nation The Interim Report of the Royal Commission on National Museums and Galleries leaves open the whole question of the governance of the national collections, both of museums and of public galleries The internal control of such institutions and their staffs by directors is clearly a desirable arrangement, but their interrelationships, policy, and development are as certainly matters of public concern The director is responsible to a Minister, where national funds are concerned, but there is usually some body between, either in a governing or in an advisory capacity The collections include countless gifts and bequests to the nation, and the nation is the trustee for these Each gift entails annual expenditure, be it book, picture, machine, or animal, and staffs have to be maintained to care for them, and to see that they are available for the study of experts and for the education and intellectual amusements of the public Catalogues have to be printed, and special exhibitions arranged, and these do not usually pay for themselves In addition, certain institutions are so clearly connected with industry and commerce, on which the country and empire so closely live, that annual expenditure is requisite for additions and for the study of these

The Museum of Practical Geology is the central institution concerned with the mineral wealth of Great Britain and with the nature of the land on which we live and build, and off which we have to obtain our water By its staff it conducts the Geological Survey in the field, and its Museum is open to the public for reference and advice The practical application of science to engineering, mining, manufacturing of every sort, and to building construction is the charge of the Science Museum, and its exhibits are judiciously designed to help these The British Museum of Natural History is, on one hand, of great intellectual value, while on the other, it deals with raw animal products both for food and industry It is a central reference station for economic biologists and is deeply concerned with the insect and other animal pests which

attack plants and animals It also has its plant department, while the practical institution for plant products is furnished by the Royal Botanic Gardens at Kew

These institutions have one characteristic in common, namely, that they are connected with one class of mankind whose sole aim is the increase of natural knowledge, and with a second larger class whose business it is to apply that knowledge to the development of the world In a word, they are scientific, and their directorates and staff belong to a group of men who are accustomed to act together in mixed societies in particular in the Royal Society, and in universities The secret of their successful co operation lies in their common basic training in respect to natural phenomena, this resulting in a peculiarly impersonal mode of examining any problem presented to them Year by year they become less separable, since most natural phenomena entail knowledge of two or more 'sciences,' and research year by year is shifting to border lines The relation of these Museums to one another and to the State deserves careful consideration, for it is obvious that they must continue to grow and progress *pari passu* with the evolution of the country and of the Empire They can no longer be considered as apart from national prosperity, for they are factors directed to assuring that prosperity, and the cost of their upkeep is a trifling premium Ideally, they must be in contact with the highest minds in their sciences and with the most interested industrialists

The position of these four foundations is that they report to and are under the financial control of four different Departments of State The Royal Botanic Gardens, Kew, are included in the parliamentary vote of the Ministry of Agriculture and Fisheries, and there is no 'governing body' other than the Minister They are not to be regarded as primarily connected with British agriculture and horticulture, for which other institutions specialise, but with the increase of the basal practical knowledge of plant growth Their staff is largely concerned with economic interests and research that are imperial in character Indeed, Kew is a central bureau in all such matters for all the dominions The herbarium is largely built up of the type collections of colonies and is essential for reference in such work Distinguished and wise directors have succeeded each other for so long that the director is as nearly independent as any Government servant can be As plant products have to be grown with an understood relationship to their method of treatment or manufacture—the business of the Science Museum—there is a slight overlapping, but this is not altogether a disadvantage We think, therefore, that Kew may be left independent of the scheme we have in mind for the Natural History, Science, and Geological Museums

These three museums are to be topographically connected with each other in the same block at South Kensington, since the Geological Museum is to be removed to a site there in close communication with the other two At present it is under the Department of Scientific and Industrial Research, which also has control of the National Physical Laboratory, as well as of numerous research boards connected with industry A committee of the Privy Council, representing many State Departments and all political parties, constitutes this Department under the Lord President and it is assisted by an Advisory Council, the members of which clearly are principally concerned with its activities in fields other than geology The detailed supervision of the work is in the hands of a competent committee of the Department The specimens displayed in this Museum are similar to those shown in the Natural History Museum, but they are arranged differently, as indeed is essential The palæontological workers are experts of the same order, and clearly the freest possible interchange and the closest relationship between these Museums is likely to be to the advantage of both The mineralogical collection of the Natural History Museum might be developed to illustrate more clearly the study of rocks, while it is surely the function of the Science Museum to elucidate physical geology

The Science Museum was a most interesting experiment, which after a chequered existence for half a century, seems to be likely to have a brilliant future in respect both to pure science and to industry It has a close connexion with the products of art, but clearly its fundamental relationship is in respect to the utilisation of the raw products, with which its neighbours are concerned The Royal Commission is clearly in agreement, since it has suggested a grant for a conference hall for discussions between industry and science, while it is pointed out that a common lecture theatre is an important need Here the Museum is under the Minister of Education, whose main interest obviously must be elsewhere and whose appointment must have been largely political There is an Advisory Council of technical and scientific men, it is true, but the members of such *purely advisory* bodies can scarcely be expected to display

that personal responsibility, the sense of which to a large degree ensures impartiality

The present seems the favourable moment for the consideration of these national museums as an organic whole We have in being a Royal Commission, the Interim Report of which shows a rare appreciation of the educational and industrial scope of these institutions, together with a fearless handling of the financial problems related to the guardianship of the public purse We believe that that essential to all governance, cheerful consent of the governed, would be found to exist were the Commission to propose a scheme which would bring the three scientific museums at South Kensington under one system of control Thus most easily can uniformity in rate of pay and in promotion in relationship to other scientific posts in the country be obtained The extraordinarily rapid changes in both science and industry necessitate the governance by experts from all sides in the closest relationship to one another, and they must be led to feel their personal responsibility Such a result can scarcely be brought about by handing these museums to an overworked Government department, controlled necessarily by experts in one direction The whole country, not one city, pays for these institutions, and their policy and development must be in the direction of national and imperial interests, the concern of many departments

Our system demands a relationship to one Minister, and, failing the direct interest of the Prime Minister, which it is too much to expect, the connexion is perhaps closest with the Lord President of the Council, who is selected for his wisdom in affairs and for his wide sympathy with every phase of national development Under this Minister there would have to be the governing body, with access to him, and with full power to report to him, and in practice to settle the policies of the museums so far as funds allow It would act through committees for each institution, with perhaps a single annual meeting of the whole body Only advantage can result from the freest discussion of policy between experts in science and industry—and unquestionably the greater and more practical men of science, as the directors of these museums must be, are happy in the discussion and justification of their views and desires for the advancement of knowledge The success of such an authority depends on the intelligence and disinterestedness of its members, qualities well displayed by the Royal Commission, which can examine many precedents and will, we trust, make specific recommendations

Greenland under Danish Rule

Greenland Published by the Commission for the Direction of the Geological and Geographical Investigations in Greenland Editors Prof M Vahl, Vice Admiral G C Amdrup, Dr L Bobé, Prof Ad S Jensen Vol 1 *The Discovery of Greenland, Exploration and Nature of the Country* Pp vii + 575 (London Oxford University Press, Copenhagen C A Reitzel, 1928) 40s net 3 vols, 100s net

HANS EGEDE landed in Greenland in 1721 for three centuries the Norse colonies had been lost , and Egede's landing was therefore the beginning of a new era of Scandinavian over lordship The missionary himself wrote a description of the country and its native inhabitants, published in Danish in 1741, and translated into English four years later There have been other general accounts, but the latest and perhaps the best known is Dr Rink s Danish Greenland," which appeared in 1877 Early in the following year the Danish Government authorised the formation of a Commission for the Direction of the Geological and Geographical Investigations in Greenland publications under the title ' Meddelelser om Grönland " began in 1879, and there are now no less than seventy volumes of this well known series In more recent years, therefore, the position has been that those wishing to obtain first hand and up to date information could only do so by searching through the seventy volumes of the "Meddelelser " The work under review is definitely meant to remove this difficulty Essentially it is a summary and co ordination of the fifty years' research contained in the " Meddelelser " It is hoped to complete it in three volumes in 1929 the present deals with the discovery, exploration, and general nature of the country , the second with the past and present population , and the third with the colonisation and history

Primarily the book is intended for officials and travellers in the country itself As a work of reference it will be quite indispensable Apart from this it is exceedingly well written, and abundantly illustrated with photographs and maps , few countries are so fortunate , it is not too much to say that this is a book to be recommended not only to those closely interested in Greenland, but also to those with slighter interests but appreciation of geographical literature well written and well produced Its nature is general rather than detailed In this connexion it should be noted that minute details, district by district, were published

in 1921 in Danish, under the title "Grönland i Tohundredaaret for Hans Egedes Landing," two volumes and atlas The completion first of the Danish work and now of its English complement will thus round off the intention of the Danish Administration, which, by undertaking these two publications, desired to mark in the most suitable way the bicentenary of Danish rule

The compilers of the present volume are for the most part well known geographers, geologists, and biologists To each has been assigned a particular division, either a physiographical account of one of the coasts, or articles on the flora, on the geology, and so on To some of the latter articles the position of Greenland, as a bridge between Europe and America, gives important significance For example, Prof Ostenfeld traces the origin of the different flowering plants, and finds that about one fifth are European, whilst the remainder (316 species) must be supposed to be of American origin, or for the smaller part to have survived the maximum of the Glacial Period in Greenland He strongly favours the survival of the hardiest species throughout the maximum glaciation, and as evidence points to the present condition on certain of the nunataks

In recent years the interest of geologists has been directed to the need of fuller knowledge of the stratigraphy and tectonics of Greenland, and this to English readers will give more than usual interest to the articles by Prof Bøggild on the geology of the country as a whole and by Dr Lauge Koch on the physiography of the northern part In Dr Koch's article will be found an account of the Caledonian folds of the extreme north west, from North Greenland these folds are marked as passing into Ellesmere Land, and their ultimate fate is therefore a problem for Canadian geologists The folding is regarded as the continuation of our own Caledonian chain via Norway and Spitsbergen, a conclusion which most will accept, though it should be noted that, while the North Greenland folds are well authenticated by fossil evidence, such can scarcely be claimed as fully proved as yet in the Spitsbergen (Hecla Hook) portion of the chain The further problem of the relationship of Koch's Caledonian Chain with the great thickness of disturbed Lower Palæozoic rocks in East Greenland, which according to Prof Bøggild run for nearly 300 miles from Queen Louise's Land to Davy Sound, has yet to be settled Here also there would appear to be Caledonian folds, and so disposed that their relationship to the Scottish North-west Highlands may be of considerable importance to the geological history of Britain

It would perhaps be invidious to select special articles without stressing the exceptional value of the book as a whole one is tempted, however, to refer to Dr Birket Smith's most able and interesting account of West Greenland physiography The article may be cited as typical of the extreme care and judgment shown by all the contributors, rash conclusions and theories are almost entirely absent, and the body of the work is essentially a collection and marshalling into proper order of the data of scientific observation By itself alone this first volume is evidence of the foresight and wisdom of the Danish Administration in Greenland, and, when complete, the work should constitute a most impressive proof of the disinterestedness of Danish rule during the last two hundred years

J M WORDIE

Cohesion, Viscosity, and Lubrication

(1) *Cohesion and related Problems a General Discussion held by the Faraday Society, November 1927* Pp 49 180 + 5 plates (London The Faraday Society, 1928) 10s 6d net

(2) *Studies in Molecular Force* By Dr Herbert Chatley (Griffin's Scientific Text Books) Pp xi + 118 (London Charles Griffin and Co, Ltd, 1928) 7s 6d net

(3) *The Viscosity of Liquids* By Emil Hatschek (International Text Books of Exact Science) Pp xii + 239 (London G Bell and Sons, Ltd, 1928) 15s net

(4) *The Theory of Film Lubrication* By R O Boswall Pp xi + 280 (London, New York and Toronto Longmans, Green and Co, Ltd, 1928) 12s 6d net

NO property of matter is more obvious, or of more continual importance, than cohesional force These four volumes deal with many aspects of its study, and of the practical application of our knowledge

(1) The Faraday Society "Discussion" presents fifteen papers, about half of which deal wholly or partially with the question of why matter in bulk breaks under a stress many times less than would be expected, from what is known about the force of attraction between molecules There is general agreement that one of the causes of this weakness is the ease with which crystal planes can slip along adjacent planes, so that crystalline substances slide apart instead of resisting a direct pull up to the limit of strength of the molecular adhesions

Whether surface cracks seriously diminish the strength is a question which receives much attention, but although at first sight there seems to be some evidence in favour of this view, it does not seem certain that the effects sometimes attributed to these cracks are not due to slip planes The plasticity of wet crystals of rocksalt remains an intriguing mystery, two papers on fatigue and hysteresis in metals leave one with a sense of the importance of incipient cracks and localities of slip, as well as of the great complication of the problem

Lennard-Jones and Miss Dent contribute another valuable paper on the macroscopic properties of crystals with a completely ionised lattice, calculating these from the electrostatic forces between the ions this type of work will surely become of increasing importance At present not much can be done except with the fully ionised lattices, where the interatomic forces are the simplest possible, but two short papers (Taylor, Rawlins) foreshadow avenues of future investigation These papers represent the limit to which we can now go in deducing the properties of matter in bulk from those of individual atoms Richards gives an abstract of his work on internal pressures, a conception which has the advantage of dealing just as readily with the effects of molecular motion as with the forces between molecules, but the disadvantage of being in all points decidedly remote from molecular theory

Other papers include a qualitative deduction of the relative strengths of the adhesions round organic molecules, from observations on surface films (Adam), observations on soldered surfaces (Crow), and on a change in dielectric constant on solidification (Errera) The discussion is not, of course, a comprehensive treatise, but deserves close attention, especially by metallurgists and engineers

(2) Dr Chatley's little volume contains notes on a variety of subjects, ranging from the internal structure of the atom to surface tension, viscosity, lubrication, etc It is scarcely thorough or accurate enough for the serious student, and seems unlikely to attract the general reader, on account of the amount of calculation introduced into the text

(3) Mr Hatschek deserves very hearty thanks for his excellent and readable survey of viscosity in liquids The book is a model of what a monograph should be the historical, mathematical, and experimental portions are thorough, a great mass of experimental results is admirably marshalled so as to show the bearings on other subjects, technical 'viscometers' have their failings succinctly described, and a comparison of their performance with that of instruments really measuring viscosity is given as far as possible If all writers of scientific books did their work so conscientiously as Mr Hatschek has here, students of all classes would have a much easier task than now faces them

(4) Mr Boswall's treatise deals with the complete, thick film of lubricant used, wherever possible, to separate the moving parts of machinery It contains a full mathematical treatment of the hydrodynamics of films of lubricant, with very detailed applications to many types of bearings, including journal bearings and the new thrust bearings with tilting sectors the effects of the motions of the metal parts are fully considered The chemical properties of lubricants, although important in determining the adhesion of the oil films to the metal surfaces, and hence in making it easy or difficult to maintain a complete film, receive scarcely any attention, but are evidently considered outside the author's province The book should be very useful to engineers with good mathematical equipment, engaged on the design of bearings N K ADAM

Non-Euclidean Geometry

(1) *Vorlesungen über nicht euklidische Geometrie* Von Felix Klein Für den Druck neu bearbeitet von W Rosemann (Die Grundlehren der mathematischen Wissenschaften in Einzeldarstellungen mit besonderer Berücksichtigung der Anwendungsgebiete, herausgegeben von R Courant, Band 26) Pp xii + 326 (Berlin Julius Springer, 1928) 18 gold marks

(2) *Leçons sur la géométrie des espaces de Riemann* Par Prof E Cartan (Cahiers scientifiques, publiés sous la direction de Gaston Julia, Fascicule 2) Pp vi + 273 (Paris Gauthier Villars et Cie, 1928) 60 francs

THE two books under notice together constitute an excellent introduction to non Euclidean geometry in all its aspects The lectures of F Klein now appear in print for the first time under the editorship of W Rosemann, though a lithographed edition was published so long as thirty six years ago The present edition has been considerably changed as the result of prolonged consultation between the present editor and the distinguished author shortly before the death of the latter.

M 1

In its present guise, Klein's book is divided into three parts, the first of which constitutes an excellent introduction to projective geometry in three chapters The first two of these, on fundamental notions of projective geometry and on forms of the second degree, are new, the third, on collineations or projective transformations, was already included in the lithographed edition The second part deals with projective metric in six chapters, the last three being concerned more particularly with non Euclidean geometry These two parts together constitute four-fifths of the book, but there is a short third part in which the relations between non Euclidean geometry and other branches of mathematics are considered very briefly, with references to Riemannian spaces and to the restricted theory of relativity The general treatment is elementary, mainly algebraical, with scarcely any reference to differential geometry, and is admirably clear and profusely illustrated by diagrams, designed to assist the appeal to intuition

(2) The second book, by E Cartan, the author of a well known book on integral invariants, is based on lectures delivered during 1925–26 at the University of Paris It deals with the geometry of Riemannian spaces almost entirely by the methods of tensor analysis and of differential geometry, and in this respect forms a welcome complement to Klein's more elementary book The treatment is based on the methods of Riemann and Christoffel, though the more recent work of Levi Cività and others is fully considered

The first five chapters are to a certain extent introductory, dealing with such topics as vector and tensor analysis, curvilinear co ordinates in Euclidean geometry, Riemann spaces which are locally Euclidean, Euclidean spaces tangent to and osculating Riemann spaces and geodesic curves and surfaces The results obtained are applied in the sixth chapter to non Euclidean spaces The seventh and eighth chapters deal with Riemannian and vectorial curvature, and the last is on normal co ordinates and their applications

This book is much more analytical than Klein's, but, considering the difficult nature of the subject matter, it is very clearly written and commendably free from misprints The two books in their several aspects can be highly recommended to those who wish to become acquainted with recent developments in general geometry and to fit themselves for an intelligent comprehension of the geometrical basis of the general theory of relativity

Biology for All

The Science of Life By H G Wells, Julian Huxley and G P Wells To be completed in about 30 fortnightly Parts Part 1 Pp 32 (London The Amalgamated Press, Ltd, 1929) 1*s* 3*d* each Part

A NEW educational venture of great attractiveness is "The Science of Life," an exposition of biology, by Mr H G Wells, Prof Julian Huxley, and Mr G P Wells, a young physiologist, son of the senior author The work aims at doing for biological science what Mr H G Wells did for history in his famous "Outline," giving to the unlearned a vivid presentation of the essential data It is to try to be "clear, complete, and correct", and if the triumvirate cannot do this, who can? There is wisdom in having three authors (tres faciunt collegium), for there is always the possibility of a majority when opinions differ

We cannot read Part 1 of this serial without envying those who are coming to biology in these days, for the presentation is so picturesque and gripping Academic formalities have been thrown off without jettisoning accuracy, and everything is discussed in its bearing on everyday life The increased availability of science promises well for the future, for it is one of the most hopeful lines of human progress that we should become more and more able to utilise our heritage of well established knowledge

If we were asked what every young student should know when beginning his voyage of life after schooldays, we should answer—(1) the most significant steps in the history of the human race, (2) how to find his way about in the world of Nature, and (3) the laws of health and happiness We are not thinking at present of brain stretching disciplines like mathematics, or of character forming influences like poesy, but of sheer knowledge We can see that this "Science of Life" is going to help powerfully towards an understanding of animate Nature on one hand, and towards an understanding of the conditions of health and happiness on the other We wish it the success it deserves

The present part begins with the nature of life, a difficult problem to start with But it is treated very concretely and with an interesting historical background In any event the reader feels that if this is biology, he wishes some more Then the story turns to the everyday life of the body—in mouse and in man, and when this can be made vividly interesting, as here, we cannot have too much of it It is tragic to think of the vast

number of young people who leave school without any understanding of their bodily functions Such ignorance may have been bliss, though we doubt it, long ago, when all the ways of living were more natural, but to day it often means disaster We do not wish to suggest that the new book is particularly designed for young people—though they will welcome it—for it appeals to all who wish more science for more life In spite of all the expositors, it has to be confessed that a large proportion of the population remain in the Dark Ages as regards the working of their bodies

There are very effective and interesting illustrations, and the frontispiece shows a crowd of skeletons receding into the distance before the light of microscopy and biochemistry This we take to mean that necrology will be recessive and biology dominant throughout this book We trust that this will be so, but it has been our sad experience that the skeleton shows great persistence in its efforts to sneak back to the feast But all success to the triumvirate !

Our Bookshelf

British Chemicals, their Manufacturers and Uses being the Official Directory of the Association of British Chemical Manufacturers (Incorporated), containing a Full List of Members, with a Classified List of British Chemicals and a Note of their Applications Pp 330 (London Ernest Benn, Ltd , 1929) 10*s* 6*d* net

Salesmanship, so far as it is regarded as a scientific art—one had almost been betrayed into writing ' artful science '—has of late been the subject of some discussion and doubtless of some new resolves To judge by the general agreement with which certain observations recently made by H R H the Prince of Wales have been received, salesmanship in the modern sense of the term is not one of the strong points of British commercial organisation, at least so far as markets overseas are concerned All the more credit and publicity should be given to the foresight of those manufacturers who have gone some way towards anticipating at least one criticism—that deploring the lack of adequate presentation to possible purchasers of information in their own languages Replacing the 1927 issue, a new edition of " British Chemicals, their Manufacturers and Uses," the official directory of the Association of British Chemical Manufacturers, Incorporated, has now been published The new volume, fully revised, is modelled on the lines of the last edition, and it is intended to bring the book up to date every second year The Association is not itself a trading concern, but exists to promote and facilitate business relations between manufacturing and chemical firms and purchasers all over the world, and to encourage legitimate international trade conditions

The directory—a sturdily bound volume—is printed (in part sectionally, in part collaterally) in English, French, Spanish, Italian, Portuguese, and German , even the title page and introductory information appear in sextuplicate A directory of members of the " A B C M " and of affiliated associations is followed by a classified list of products, their uses, and the names of British manufacturers There is also a list of proprietary and trade names, the corresponding chemical synonyms or descriptions, and again the names of manufacturers There is, for example, no longer any need for perplexity regarding the nature or origin of abralac, acrosyl, adalin, or even of westrosol, yarnite, or zinc formosul Since the list of products is arranged in the alphabetical order of the English names, supplementary indexes in the other languages are provided The reviewer understands that although the volume is offered for public sale by the publishers, Messrs Ernest Benn, Ltd , the Association, the address of which is 166 Piccadilly, London, W 1, will nevertheless send a complimentary copy to any applicant who is actually concerned with work in pure or applied chemistry A A E

The Origins and the Growth of Chemical Science By J E Marsh Pp x + 161 + 10 plates (London John Murray, 1929) 5*s* net

Mr Marsh endeavours to show that chemistry has advanced, not through haphazard experiments and discoveries, but by a gradual development of accepted knowledge with the application of logical reasoning to explain established facts Thus, when Boyle found that mercury calx was re converted into the metal by heating alone, he was unable to explain the fact When the phenomenon was rediscovered a century later, science was ready for it Joseph Black had observed the fixation of a gas in carbonates and the genius of Lavoisier enabled him to establish and explain the fixation of another gas in calxes

In tracing the growth of chemical science, the author has discarded the practice initiated by Kopp of dividing the development into epochs, since he considers this allows the dominant views of the time to obscure many important tendencies He instances the phlogiston epoch, which Kopp dates from 1650 to 1775 The discoveries of Boyle and Black are thus made to fall within the same period, yet Boyle never heard of the theory, which was only promulgated in 1702 and, moreover, did not come into prominence until Lavoisier began to attack it in 1775

The book opens with an account of the early views on the phenomena associated with fire, a study of which led to many important observations This section, and those dealing with alchemy, the fixation of gases, and some of the later ones cursorily tracing the theories of structure, are well written In dealing with the philosopher's stone, Mr Marsh has, however, accepted the doubtful view that Talbot and Kelley are the same person

The section devoted to the discovery of the elements, which follows an account of Mendeléeff's periodic law and other generalisations under the title "Atoms and Ions," is perhaps not so useful as it might have been Here the references to the literature are quoted in a confusing manner Frequently the year, volume, or page (sometimes two) are omitted, and German titles are occasionally misspelt (*e g* Poggendorff's *Annalen der Physik*), and the reference (p 144) for 'the octet theory of valency' (Abegg *Zelt An Org Chem*, **39**, 330) will irritate those who desire to consult the original

In spite of this minor defect, the book presents a useful survey of the origins and development of chemical science J G F Druce

Introduction à l'étude de la physique théorique Par Prof René Fortrat Fascicule 6 *Mécanique statistique* Pp ii + 100 (Paris J Hermann, 1927) 10 francs

It is always rather difficult to estimate the value of one detached section of a larger work, for the scale and plan of the whole work can only be guessed This difficulty is particularly noticeable in attempting to review on its own merits this section of Prof Fortrat's work entitled "Statistical Mechanics"

To write a successful fairly elementary account of statistical mechanics in a hundred small pages is a task requiring great delicacy of judgment in selecting material On such questions of taste one need not ask for complete agreement, but the reviewer is forced to admit that he finds the author's judgment poor In the first place, the last forty pages of the book are devoted to two chapters on the older quantum theory of the atom, too slight to be of much value in themselves and entirely irrelevant to the professed subject matter They contain, incidentally, statements about the discrepancy between the magnetons of Bohr and of Weiss which might lead an unwary reader to suppose, contrary to the facts, that there is a real difficulty and that the Weiss magnetism is still of some theoretical importance

The remaining relevant sixty pages are rather good and rather unusual The subject is treated from the conventional probability point of view, but the ideas and computations of the theory of probability are presented in detail and well illustrated in a way which owes much to Langevin The applications of the theory have the pleasing and unusual feature of being mainly to magnetic phenomena There are good short accounts of Langevin's theory of paramagnetism and Weiss's theory of ferromagnetism If the rest of the book were of the same standard, it could be warmly praised R H F

The Mechanics of Rowing By W B Coventry Pp viii + 70 (London E and F N Spon, Ltd, New York Spon and Chamberlain, 1928) 4s 6d net

This is an interesting addition to the literature of rowing, and the work is soundly based on Newtonian mechanics The terms used are carefully explained, as is also the fundamental problem of connecting the equation of motion of the blade of the oar with the equation of motion of the boat The variable nature of the effective propelling force is dealt with by the introduction of a constant 'mean effort' operating from the catch to the finish of a stroke

In the application of the theory to definite examples, it is rightly recognised that, in the last resort, the solution depends on the 'personal equation' of the oarsman Discussion of such subjects as the length of the stroke, the sliding seat, the weight of the crew and of the coxswain, indicates the practical interest in the racing 'eight' round which the book centres The effect of the density of the water is dealt with, and perhaps reference might have been made to Thomson's theorem and its application to the hydrodynamical problem of rowing a boat in shallow or deep water The book concludes with emphasis on stamina and quickness as more valuable assets than big muscles H D A

Eutychus or the Future of the Pulpit By Winifred Holtby (To day and To morrow Series) Pp 142 (London Kegan Paul and Co, Ltd, New York E P Dutton and Co, 1928) 2s 6d net

Miss Holtby's clever book, which reminds one occasionally of Oscar Wilde, is well worth reading Students of science are perhaps not much interested in the future of the pulpit, and may agree with Anthony, the young intellectual, that "the pulpit has no future because religion has no future" But the book does, among other things, present an accurate picture of a certain type of vulgar sentimentality which pervades large sections of a modern community Men of science for the most part are quite unaware of its existence, since their work only brings them into touch with intelligent people In this dialogue, Eutychus is the exponent of popular religious notions, the devotee of what we may call 'Abide with me' religion, with its cinema mentality and vulgar emotionalism Moreover, Eutychus feels that he holds all the cards "Whatever the sermon is to be you may be sure that it depends upon just how much I and my friends can stand you've got to pay attention to what we stand for," says he No wonder that Fénelon, the exponent of Catholic orthodoxy in this dialogue, sums up the situation by saying, "It is the influence of Eutychus which alarms me most" J C H

A First Book of Experimental Science By W A Whitton (First Books of Science Series) Revised and enlarged edition Pp vii + 194 (London Macmillan and Co, Ltd, 1928) 2s 6d

A welcome will be given to this enlarged edition of a school book which has already proved its worth As to standard, it suits candidates for the junior local examinations, and as to scope, it deals with hydrostatics, mechanics, heat, and a little chemistry

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications]*

The Equivalent Heights of the Atmospheric Ionised Regions in England and America

IT was recorded in NATURE of Sept 3, 1927, that, in experiments carried out for the Radio Research Board of the Department of Scientific and Industrial Research, evidence had been obtained of the existence of at least two ionised regions in the upper atmosphere This evidence was derived, in the first instance, from observations made at night using wireless waves of medium length as the atmospheric exploring agency, but, more recently, the use of short waves has made it possible to carry out similar experiments during the daylight hours The results of these experiments confirm the earlier conclusion as to the existence of the two ionised regions while the use of short waves, as was anticipated, markedly lengthens the period during the twenty four hours when the lower region is penetrable and the upper region accessible Using a wave length of just under 100 metres, it is found that even about mid day the lower region is penetrable on some days On other days it is found that due to the inhomogeneity of the lower region, waves of this length are reflected by it one moment and a short time later got through This is illustrated by a typical series of observations made at King's College, London, on Jan 13, 1929, using 99 8 metre waves emitted by the National Physical Laboratory transmitter at Teddington, for which the following equivalent heights (km) of reflection were recorded at 10 minute intervals between 1000 and 1400 G M T 229 229, 236, 244, 217, 229, 229, 230, 204, 196, 229, 100, 99, 93, 98, 99, 96, 98, 232, 99 (and 220), 99, 229, 229, 99

It will be seen that these heights fall into two definite series, of mean values 226 km and 98 km

Now measurements of the equivalent height of the ionised layer have also been made in America, and it is of interest to compare the English and American results under similar conditions For example, Breit, Tuve, and Dahl (*Proc Inst Rad Eng*, vol 16, 9, p 1236, 1928), employing their elegant group retardation method, have recorded that, at Washington, using 75 metre waves, they obtained evidence of multiple reflections in that effective heights in the ratio 1 2 4 had been measured The actual heights recorded were 105 km , 225 km , and 450 km

Now we may identify the value of 105 km in America as corresponding to the 98 km (lower region) in England But in considering whether the remaining rays are multiply reflected rays from this region or not, we may note that, in terms of such an explanation, the triply reflected ray is missing and that the photographs show that the doubly reflected ray is often of greater intensity than the singly reflected ray Both of these difficulties disappear if we adopt the double layer hypothesis for the American results as well as for the English observations. According to this explanation, singly reflected rays were obtained at Washington from regions at heights of 105 km and 225 km , and a doubly reflected ray was also obtained from the upper region A close correspondence with the English mean values of 98 km and 226 km is thus obtained

E V APPLETON

Wheatstone Laboratory,
King's College, London,
Mar 6

Solutions and Heat Engines

IT is not usual for an author to complain of a review of his book, but I confess that the theory of osmotic pressure put forward (in place of an account of my own reasoning) by the reviewer, in NATURE of Feb 16, of my book "Gases and Liquids," almost took my breath away As the reviewer's reply, in NATURE of Mar 9, to Prof Armstrong's criticisms of this theory seems to me totally inadequate, perhaps I may be allowed space for some remarks

The reviewer says that in a solution "the effect of the bombardment [by solute molecules] is to tend to expand the volume of the solution, and that therefore if water can flow in through a membrane it will do so" This theory implies that a net positive expansion pressure acting from within on the walls of the containing vessel is produced owing to the presence of the solute, and at the same time a net negative pressure causing water to pass in Any less coherent theory I am unable to conceive In a solution, no appreciable pressure towards either the outside or inside of the solution exists until the semi permeable partition is brought into contact on the outside with pure solvent or a solution not isotonic with the solution in the osmometer There is no pressure because, though the solute molecules exercise pressure, the pressure of the solvent is correspondingly diminished, just as, with gas at constant volume and pressure, there is no change of pressure when we substitute an equal volume of another gas at the same pressure for part of the original gas The osmotic' pressure which develops in an osmometer is quite evidently due to the fact that the more concentrated molecules of the pure solvent diffuse through the semi permeable membrane faster, until the full osmotic pressure is developed, than the diluted solvent molecules in the solution It is thus to the solvent, and not to the solute molecules, that the pressure is due, as Prof Armstrong has pointed out

In my book I have developed this theory quantitatively, and shown, as I think, that it gives the actual experimental figures for depression of freezing point elevation of boiling point, and osmotic pressure, though not what van t Hoff wrongly thought were the figures While I am sorry that the review has given no account of the reasoning in the book, I must not complain but I think I am justified in joining my protest to that of Prof Armstrong against what seems to us and many others the incoherent theory put forward by the reviewer

I have tried in my book to be fair to the memories of van t Hoff and Carnot, both of whom were men of outstanding genius But where they were in error they were just in error, like other mortals

J S HALDANE

DR HALDANE considers my statement of van 't Hoff s theory (it is not mine) as incoherent I cannot do better than quote, as an alternative statement, from the account of osmotic pressure in the book under review (p 109) "Let us imagine pure hydrogen and pure nitrogen at ordinary atmospheric pressure and contained in two equal gas tight chambers separated from one another by a rigid septum permeable to the hydrogen but completely impermeable to the nitrogen The hydrogen contained in chamber 1 will immediately begin to diffuse into the nitrogen in chamber 2, and will continue to do so until the pressure of the hydrogen is the same in the two chambers If the pressure in the first chamber is kept constant, by reducing its volume or letting in hydrogen as required, the pressure in the second chamber will be two atmospheres"

No better illustration than this can be given of osmotic pressure, which in this case is one atmosphere (*i e* the difference of pressure between the two sides of a semi permeable membrane when equilibrium exists) This extra pressure is due entirely to the fact that on both sides there is now hydrogen at one atmosphere pressure, but in No 2 there is nitrogen as well Thus there is the extra bombardment inside, and in this simple case (assuming the gases perfect), it is calculable exactly from the expression $pV=nRT$ The nitrogen bombards also the semi permeable membrane, but this does not prevent the hydrogen from coming in (though with actual molecules, presenting a broad front for attack, it will slow down its *rate* of coming in) It maintains a space extended to receive the hydrogen molecules If the vessel can stretch, it will do so in consequence of this extra bombardment, and fresh hydrogen will come in to equalise the pressure of the hydrogen once more

Now, whether we are dealing with gases at low or at high pressures, this kinetic pressure is the same at any given temperature Perrin's experiments make it certain that it is so even for a condensed gas (*i e* a liquid) Serious complications then come in, however, which make exact calculations impossible, but the kinetic pressure is there all the time, and for solutions so dilute that the solute molecules are out of each other's way most of the time, it is found from osmotic measurements to be practically that which a gas would exert if of the same molecular concentration and occupying the same space alone It is no use, therefore, trying to drag in other causes to explain the existence of osmotic pressure, and in any case it is inexcusable to neglect the kinetic effect

Dr Haldane attempts to attribute the *whole* phenomenon to certain volume relations depending upon the replacement of little molecules of solvent by big molecules of solute (thus ignoring the forces which govern the affair), the van 't Hoff school treats these simply as complications, and recognises at the same time that questions depending upon the sizes of molecules and of the attracting forces between them are problems of such extraordinary difficulty that the accurate allowance for their influence has not yet been effected In dilute solutions their effect is certainly very small

Dr Haldane is not at all clear on this part of his subject, and since his whole theory depends upon the precise assumptions made, I thought it best in my review to be content with indicating that the theory was a superfluity, a *vera causa* having already been recognised and successfully developed Since, however, he evidently desires me to do more, I must mention that on p 25, where he introduces the volume relations which are the basis of his 'theory,' the results deduced are algebraically wrong So that, even assuming that the fairly simple gas law which he takes is good enough, the conclusions that he draws are unfortunately incorrect I sympathise with him for, also unfortunately, I am personally acquainted by experience with many of the pit falls which abound

THE REVIEWER

Perturbations in the Band Spectrum of Helium

RECENTLY Kronig put forward a theory of perturbations in band spectra (*Zeit f Phys*, **50**, 347, 1928) He found that if two molecular terms with the same j, which have besides to fulfil certain other conditions, come close together, their mutual influence has the effect that they seem to repel each other Hitherto no band spectrum has been sufficiently known to permit of testing Kronig's predictions

In the helium band spectrum a great number of electronic terms is known, and it is therefore especially well suited for a test of the theory of the perturbations In Fig 1 the empirical differences between the $4s(j)$ and $4z(j)$ states are represented as a function of j We see that for $j=17$ the corresponding energy levels come very close together, and as the two levels fulfil

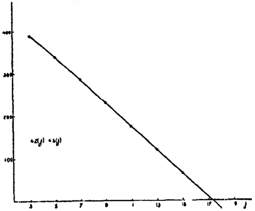

FIG 1

all the requirements of Kronig's theory, we must expect that they will be shifted from their normal positions Fig 2 shows how the empirical terms are distributed in the vicinity of the critical point The dotted lines give the positions which the terms would have if there was no perturbation The actual term values derived from the analysis of the bands $2p-4s$ and $2p-4z$ show just the expected deviations (The absolute value of the perturbations has been exaggerated in the figure in order to make it better visible) The exact position of the terms with $j=19$ and higher is not yet quite sure, as there is a choice of several unclassified lines in that region It is certain, however, that although the intensity of the preceding lines is large enough, so that we can also expect with appreciable intensity the lines having the terms $4s(17)$ and $4z(17)$, etc, as initial levels, they are not present in the extrapolated positions Therefore it seems certain that we have indeed here a mutual interaction between the corresponding s and z terms Similar perturbations seem to exist for the five quantum terms, but as the situation is not so unambiguous as in the case mentioned above, their communication is reserved for a later occasion In the case of three quantum terms, a similar approach of terms with the same j does not take place, and accordingly perturbations have not been found

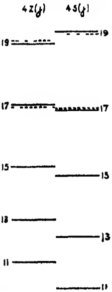

FIG 2

The perturbation of the $4p(9)$ term first found by Curtis in the Q branch of the band $\lambda 367$ mμ, seems to be of a somewhat different nature A term which might interact with the $4p$ term so as to give perturbations is not yet known It does not seem impossible that the initial term of the band $\lambda 535$ mμ analysed by Fujioka (*Zeit f Phys*, **51**, p 657, 1928), which shows a perturbation for the same value of j, is

the term which is responsible for them The perturbation of the $4p(9)$ term shows a doubling of the corresponding Q line into two components with unequal intensity This might be explained in the following way The spectrum of the helium molecule must consist of single and triple electronic terms But as the interaction of the electronic spin with the rest of the molecule is very small, the triplets are not resolved and thus have the appearance of single levels It seems possible that in the case of a perturbation the interaction with the spin gets an abnormally large value, so that the corresponding term is split up We must imagine, then, that the more intense component of the corresponding line is, as in the case of the atomic lines of helium, an unresolved doublet

Full particulars of these and other properties of the terms of the helium molecule will be given elsewhere

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Cosmic Rays

IN an earlier communication [NATURE, Feb 16, p 241] it was stated that an examination had been made of the results of experiments on cosmic rays The experiments referred to were those of Millikan and his colleagues In a recent paper (*Physical Review*, October 1928), Millikan and Cameron divide the rays into four bands with absorption coefficients per metre of water, 0 30, 0 08, 0 04, and 0 02 respectively There is very little, if any, evidence for the existence of the last band, and I find that their results are fitted just as well by the division of the rays into two bands only, with absorption coefficients 0 30 and 0 051 respectively, rays of type A and type B, say The experiments of Millikan and Otis and others show that there is a third type of radiation present, type C, say Rays of this type are of local origin and consist, in part at least, of β rays with an energy of the order of 100,000,000 electron volts

Rays of type B are probably γ rays If so, according to the Klein–Nishina formula, which, for large values of $\alpha = h\nu/mc^2$ reduces to

$$\sigma/\rho = \frac{4\ 17}{\alpha}(1 + 2 \log 2\alpha) \qquad \text{per metre of water}$$

α for these rays equals 173, corresponding to an energy of 88,000,000 electron volts

Rays of type C are doubtless γ rays, with a value of α equal to 1330 and an energy of 675,000,000 electron volts

The energy presumably released when an oxygen nucleus is formed in a single step from protons and electrons is 116,000,000 electron volts, and that when a proton is destroyed 940,000,000 electron volts I believe that the formula used gives values of α which are too small, so that rays of type B may correspond to the radiation emitted when an oxygen nucleus is formed in a single step and those of type C to that when a proton is destroyed Incidentally, it has been tacitly assumed that rays of both types exert no appreciable action on hydrogen and oxygen nuclei The evidence that rays of either type have any effect on atomic nuclei is not conclusive

An analysis of the results of experiments showing the variation of intensity of cosmic rays with depth below the surface of the atmosphere affords, then, no evidence of rays corresponding to the formation of helium nuclei from protons and electrons This renders it difficult to accept the attractive hypothesis of Millikan and Cameron that atom building is taking place in outer space, following the transformation of radiation into protons and electrons Another difficulty that occurs is this If all the energy in starlight is so transformed, less than eight tenths of one per cent of it can be re radiated as cosmic rays As the radiation from the sun apparently has no effect on the intensity of the rays, this amount seems too small to account for the large intensity of cosmic rays, estimated by Millikan and Cameron to be about one-tenth that of starlight

Rays of type C are not easy to classify Their intensity in air is approximately proportional to that of the rays of type B, although it is difficult to estimate the exact value of either They are not produced in water or in lead, and are therefore not recoil electrons Many methods of explaining their origin have been tried, one being that they are photoelectrons ejected from the nuclei of atoms such as nitrogen, but this explanation is not altogether satisfactory

We have assumed that rays of type A and C are cosmic in origin, the greater part of the evidence favouring this view, but one experiment carried out by Millikan and Otis indicates that a part at least of these rays may be of terrestrial origin and also that rays of type C may be more penetrating than is usually assumed They measured the ionisation in an electroscope before and after a snowstorm When the electroscope was shielded by 4 8 cm of lead the ionisation per c c per sec (corrected for natural leak) dropped from 4 9 to 3 6 If this result is not due to experimental error, it would appear that something had occurred in the atmosphere to diminish the intensity of the rays of one or more types

A more complete discussion of the questions raised above will be given later In searching for an explanation of the results, equations of the following type have been used, namely

$$14\ 008x + 4\ 0022x + \alpha_k = 17\ 000x + 1\ 0078x + p_k + A_k + h\nu$$

This is an energy equation representing the ejection of a proton from a nitrogen nucleus by an α particle, the α particle being captured by the recoil atom forming an oxygen isotope of mass 17 (the number 17 being assumed) x represents the energy in electron volts radiated when unit mass is destroyed (the mass of an oxygen nucleus being taken as 16 units), α_k, p_k, A_k, and $h\nu$ representing the kinetic energies in electron volts of the α particle, ejected proton, recoil atom, and assumed radiation respectively

$$h\nu = 0\ 0024x + \alpha_k - p_k - A_k$$

As $x = 930{,}000{,}000$ electron volts and $p_k + A_k$ is less than α_k, $h\nu$ should be greater than 0 0024x, that is, than 2,230,000 electron volts

It should be possible to detect radiations of this type Similar equations have been written down for the other atoms from which protons can be ejected, but the results are somewhat indefinite, as we do not know the mass of the recoil atom

J A GRAY

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Feb 7

The Ice Age and General Drayson's Theories

I AM sure your able contributor H C P did not intentionally misrepresent Drayson in his article in NATURE of Dec 29, p 1002, but it would seem that some initial unfamiliarity with Drayson's writings, or possibly lack of sympathy with his claims, has led to misapprehension, and I would ask you to be so good as to permit me to direct attention to the more serious mistakes

(1) "Everywhere in the Draysonian literature nutation is simply ignored"—Nowhere, and at no time, did Drayson ignore nutation, in proof, see "Untrodden Ground in Astronomy and Geology," p 83, "Motion of the Fixed Stars," p 23, etc, though, in common with Sir John Herschel and all other astronomers, when tracing the path of the pole, he had, inevitably, to deal with the *mean* path The greatest amplitude of nutation, that is, the whole nodding movement across the *mean* path, in direction towards the centre of the circle traced by the pole, is only 18½ seconds of arc It would need to be 1167 (one thousand one hundred and sixty seven) times that amount to explain the 6 degrees remove of the precessional centre from the ecliptic pole which Drayson discovered on examination of the records for the previous fourteen hundred years

(2) "Further than this, the description, such as it is, is devoid of any dynamical basis"—Over and over again, in all his writings, for example in "Untrodden Ground," pp 256 259, Drayson directed attention to the existing terrestrial conditions that would appear to necessitate a precession different from that assigned to the earth by the mathematicians, a difference he demonstrated by actual experiment with the gyroscope It is not quite correct, therefore, to say that the movement he described is devoid of any dynamical basis While it would be out of place to question the calculations of the master mathematicians who have determined the precession dynamically, may it not be reasonable to suggest that the data on which their workings are based are necessarily in the nature of assumptions, difficult, if not impossible, to verify and liable to modification ?

May I add that, while it is not necessary to contend for every word that Drayson has written (and he himself was frank to own the limitations of his single handed research), the need all through has been for simple recognition of the fact that he was offering to science something well worth the trouble of bona fide examination and the need to day is as great as ever for co operation of friendly team work, in place of aloofness, to thresh out the question in all its bearings and harvest for science all that is of permanent value

T C Skinner

Reigate

The moderation of Lieut Col Skinner's letter, in marked contrast to the tone too often adopted by the advocates of Drayson's theory, entitles it to a reply, though without any hope of changing settled convictions The invitation to join in friendly co operation under the banners of Laplace, Poisson, and General Drayson is touching and deserves to be appreciated

Casual mention of a matter like nutation is quite consistent with ignoring it in practice Col Skinner denies that it has been ignored, and at the same moment seeks to justify that course on the plea that nutation is very small But the problem which Drayson approached was that of the motion of the earth about its centre, and in that problem dynamical astronomy has to deal with precession and nutation together From this point of view the relative magnitude of the latter is irrelevant As well might one leave out of sight the loops in a row of knitting on the ground that very fine needles were used

This failure to grasp the integrity of the problem in itself betrays the lack of any dynamical basis in the treatment of it Col Skinner refers to mistakes, and has had an opportunity of correcting them It will be observed that in the one case he has failed to indicate what part, if any, nutation plays in the Draysonian scheme, and in the other he has not suggested in what way, if any, the scheme derived support from dynamical reasoning of any kind Drayson may have alluded to nutation and toyed with gyroscopes (most people have spun tops in their time), but what remains as obscure as ever is what part these things played in a theory the purely geometrical and empirical character of which is as clear as day

An attitude of Athanasius *contra mundum* may be impressive, but the majority is not invariably wrong The work of the master mathematicians, so far from being sacrosanct, has received repeated and critical study The unfortunate thing is that Drayson and his followers have never shown the slightest inclination to come to close grips with it When they have undergone this arduous discipline, they will have formed a juster view of the situation H C P

Compressibility of Crystals and the Exponent of the Force of Repulsion between Atoms

It is recognised that a real crystal does not have a perfectly uniform structure, but that it consists of a large number of small perfect crystals with a system of submicroscopic cracks between them The average size of the perfect unit is, according to A Smekal (*Zeitschrift fur technische Physik*, p 535, 1926), about 10,000 molecules The presence of the submicroscopic cracks is made responsible for the tremendous difference between the experimentally determined values of tensile strength and those computed from theoretical considerations As is known, the latter are several hundred times larger

M Born ('Atomtheorie des festen Zustandes,' pp 734 735) calculates the exponents of the forces of repulsion between the ions in a crystal lattice from the compressibilities of the crystals In this way he arrives at the well known value 9 from which certain conclusions of importance are drawn as to the symmetry of electronic arrangements in the ions (resp atoms) The fundamental implicit assumption of all calculations of such a kind is that the coefficient of compressibility, as determined by the usual methods, is characteristic for the ideal crystalline space lattice

Are we justified in making this assumption? If the tensile strength of a crystal is reduced several hundred times due to its loose structure, should we not expect that the compressibility, as usually determined, is also a characteristic, not of the ideal perfect crystal, but of the real loose crystal ? It is easily seen that if the above mentioned structure of the real crystal should have any influence at all on its compressibility, the effect should be one of increasing the latter When subject to compression, the real, loose crystal may decrease in volume solely due to closer packing of the perfect units, that is, due to a decrease of the volume of the system of submicroscopical cracks The compressibility of the individual crystallites may be very small, even zero, and still the crystal as a whole may show a considerable reduction of volume under pressure

It is difficult to estimate how large such an effect may be But the following considerations may give some indications According to Siedentopf, the width of the submicroscopic cracks is of the order of 10^{-7} cm (W Rogowski, *Archiv fur Elektrotechnik*, vol 18, p 147, 1927) Assuming the crystallites to be cubical, we find that there are about 21 atoms along the edge of the cube If, furthermore, we

assume that the width of the crack given above represents the average spacing between the adjacent crystallites, we find that the total volume of the cracks is of the same order of magnitude as the volume actually occupied by the perfect crystallites This is certainly much too high an estimate But it now becomes not improbable to assume that the total volume of the cracks equals within a few per cent the volume of crystallites The compressibilities being of the order of 10^{-6} cm ^{2}/kgm , we see that even at pressures of about 10,000 atmospheres the relative change of volume is only a few per cent Hence, it is not impossible that practically the whole change of the volume is due to the decrease of the size of the cracks

Hence we see that the measured compressibilities may be considerably larger than those which would be found if we dealt with a perfect crystal But this means that the exponents of the forces of repulsion between the ions are considerably higher than 9 If this should be confirmed, it would necessitate also a revision of some of the conclusions drawn from previous data It is perhaps worth noting that J E Jones (*Proc Roy Soc*, A, vol 106, pp 441, 463, 1924, and vol 107, p 157, 1925) finds for some gases considerably higher exponents from different considerations

Since the system of cracks in a real crystal is of prime importance also for a great number of other properties, such as conductivity of dielectrics, optical phenomena (Smekal, *l c*), and electrical break down strength (Rogowski, *l c*), it may perhaps be possible to investigate this question by the study of the above mentioned properties under high pressures

N RASHEVSKY
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Jan 16

The Beta-Hormone

THE œstrous cycle is but one phase, and the less important phase, of the whole sexual cycle There are *no* mammals in which the reproductive phase of the cycle (pseudo pregnancy) does not also occur —either regularly or under given conditions But there are *some* (the primates) in which no œstrous phase appears, since the whole cycle consists of a pseudo pregnancy Pseudo pregnancy depends upon a hormonic function of the ovary, and is entirely independent of the presence of ova, fertilised or unfertilised, mature or immature (Wiesner, 1927) It becomes necessary, therefore, to decide whether pseudo pregnancy is caused by the same hormone or hormones as that which invokes the œstrous cycle

Alpha hormone (œstrin—the cornifying factor) in particular must be tested But Wiesner has shown that alpha does not produce the typical changes of pseudo pregnancy Moreover, an already existing pseudo pregnancy can be interrupted by injections of alpha

In an attempt to explain the mechanism of the sexual cycle, the assumption was made that there existed a second ovarian hormone which was required to act in two ways (*a*) to prevent alpha causing œstrus (in animals where alpha occurs during the second phase—be it pseudo pregnancy or pregnancy), (*b*) to produce the typical changes of pseudo pregnancy which cannot be produced by alpha

Recent work done by Wiesner in 1927–28 and by ourselves aimed at the isolation of this hormone or the factors of which it consists Now we have found that the corpus luteum contains a substance which can be extracted and causes at least some of the effects ascribed to this hypothetical beta hormone

The method of extraction was one of those which were used in the preparation of rho one (ρ_1)—that particular 'pituitary' hormone which causes œstrus and ovulation in the diphasic animal (Wiesner and Crew, 1928) The simplest method is that of shaking an aqueous suspension of finely divided substance of corpora lutea (cattle) after addition of sulpho salicylic acid (conc about 15 per cent) A precipitate forms, and filtration leaves a large part of the beta in the liquid, the evaporation of this extract at 56° and the removal of the sulpho salicylic acid from the residue by means of alcohol leaves a water soluble substance the injection of which can produce effects required of beta by the working hypothesis For it prevents the atrophy of the uterus in ovariotomised mature mice, a phenomenon appearing normally in all castrated animals, the muscular layers of the uterus of the experimental animals showed full development The epithelial cells are increased in number and size high epithelial activity prevails The uterus never appears to be dilated by fluid (as it is after injections of alpha) The vaginal epithelium is *not cornified*, but forms *a layer of high mucous cells*—as in pregnancy or pseudo pregnancy

The effects caused by this substance, the beta factor of the ovarian hormone, permits one to conclude that it is one, if not the factor, which is responsible for the second phase of the sexual cycle (pseudo pregnancy) in diphasic animals and for its equivalent (premenstruum) in monophasic animals

Further purification of the extracts and a study of the effects of beta is the object of experiments now in progress, the formation of that particular vaginal epithelium which can be recognised in a small excised piece of the vaginal wall and is characteristic for the second phase is used as the test for the presence of this ovarian hormone, which is the second, but most probably not the last one to be extracted and described

B P WIESNER
JASHBHAI S PATEL
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Feb 24

Practical Television and its Problems

THOUGH I see that it is largely taken from a foreword written by so high an authority as Sir Ambrose Fleming, I should like to put on record my strong dissent from a sentence in the review of A Dinsdale's book "Television," in the supplement to NATURE for Mar 9 The statement that I object to is "The great obstacles to radio television to great distances at present are the disturbances caused by fading Morse signals, atmospherics, and all the other causes which mutilate the broadcasting of speech and music"

On the contrary as a matter of fact, if the difficulties occasioned by all these troubles were entirely eliminated, there would remain two fundamental, and, so far as present methods are concerned, insuperable difficulties against obtaining really successful practical radio television

The first, which applies to all television, either by radio or by wire over distances either long or short, is, that with present mechanical methods it is only possible to produce transmitting or receiving apparatus with which the pictures can be divided into numbers of units which, for real success, would have to be multiplied at least by hundreds, if not by thousands

The second difficulty applies only to television by

radio and not by wire, but applies obviously to broadcasting, and consists in the fact that where television is made by radio, such broad bands of frequencies must be used in order to get the necessary details to form really successful images, that these bands must cause unbearable interference with all other wireless systems in the neighbourhood

I may add that I have received both a letter, dated Mar 1, and a copy of an article in the *Elektrotechnische Zeitschrift* for Nov 29 last, from Prof Arthur Korn, of Charlottenburg, the well known pioneer in the transmission of pictures by telegraph, that fully bears out these views of mine He says in his letter, "In reality, I think that all the present trials of television are without great practical value, and only when it will be possible to receive many hundreds of thousands of elements per second practical television will begin"

A A. CAMPBELL SWINTON

MR CAMPBELL SWINTON loses few opportunities of attacking mechanical methods of television We have seen what we and many experts, including Sir Ambrose Fleming, consider excellent pictures transmitted by mechanical television It is somewhat late in the day to point out difficulties in the way to experts As Mr Campbell Swinton has quoted Prof Korn, we may be allowed to quote the following extract from a letter dated Feb 19, by Commandant Brenot, Chief Engineer of Radio Paris, one of General Ferrié's most brilliant pupils "What Mr Baird has done is far ahead of what the most optimistic spirits could have dared thinking only a year ago at the International Wireless Conference held in Washington"

Six or seven stations in America are already broadcasting television pictures by various methods with a somewhat limited amount of success Experimental transmissions on the Baird system will shortly be tried in various continental countries The matter is being considered at present by the Post Office officials in Great Britain and we are quite content to leave the question of broadcasting television in their hands, as we know that they are competent and quite unbiased

THE REVIEWER

Magnetic Storm of Feb 27-28

ON Feb 27-28 occurred one of the greatest magnetic storms recorded at this Observatory in the present solar cycle The range in declination (100′) has been exceeded once only, on Oct 15, 1926 (>164′), in the cycle, and that in horizontal force (530 γ) has been exceeded on three occasions only, namely, on July 8, 1928 (>600 γ), Oct 15, 1926 (>717 γ), and April 14-15, 1926 (585 γ) In both the recent storm and that of last July the minimum of H F was beyond the limits of registration, so that it is not possible to give the exact value of the range

The recent storm was not marked by a 'sudden commencement,' but was preceded by slight and moderate disturbances respectively at about the same hours on the two previous days The duration of the storm was approximately from 15 h 30 m on Feb 27 to 4 h on Feb 28, but the more violent phase was confined to the interval between 18 h 30 m on Feb 27 and 1 h 30 m on Feb 28 The character of the record strongly suggests that the violent phase of the disturbance was due either to a different cause from that responsible for the more moderate disturbances at the beginning and end of the storm, or to a marked discontinuity in the conditions under which a common cause operated This is especially observable in the declination record, in which all the maxima and minima of the violent phase are sharply pointed, whereas in the initial and final stages they tend to be rounded Further, the beginning and end of the central phase are very sharply marked, especially the end, which is as abrupt as if it had been brought about by the opening of a switch on an electric circuit

It is worthy of note that the most violent movement of the storm was centred at about 20 h on Feb 27, at which time, according to reports in the Press, telegraphic services were seriously disorganised Between 21 h 42m and 21 h 57 m there was a rise of 72′ in declination, followed by a fall of 80′ between 21 h 57 m and 22 h 2 m, whilst between 21 h 53 m and 22 h 8 m there was a rapid fall and rise in H F of over 370 γ, the trace being off the sheet from 21 h 58 m to 22 h

There were a few insignificant groups of spots near the central area of the solar surface, but nothing which would lead one to anticipate any notable magnetic disturbance, nor does the storm appear to be in sequence with any previous ones at about the 27 day interval It will, however, be interesting to see if it is followed by another at about Mar 26, and, if weather conditions are favourable, it would be well if observers would be on the look out for aurora at about that date

J P ROWLAND, *S J*

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Mar 7

The Presence of Sulphur in the Gaseous Nebulæ

MANY of the strongest lines in the spectrum of the gaseous nebulæ have been explained (NATURE, **120**, p 473, 1927 *Astrophys J*, **67**, p 1, 1928) as forbidden transitions from low metastable states in oxygen and nitrogen The analysis of the S II spectrum by Ingram (*Phys Rev*, **32**, p 172, 1928), combined with the intercombination lines recently classified by L and E Bloch (*C R*, **188**, p 160, 1929), makes possible the prediction of the position of lines due to similar jumps in singly ionised sulphur as follows

Transition	λ Calculated	λ of Nebular Lines
$a^4S - a^2P_2$	4068 39	4068 62
$a^4S - a^2P_1$	4076 45	4076 22
$a^4S - a^2D_3$	6717 04	—
$a^4S - a^2D_2$	6731 30	6730 0

The last column of the table gives the wave length of lines found in the nebulæ The agreement in every case is within the error of the calculated wave lengths, which depend on frequencies of lines in the extreme ultra violet 4068 62 and 6730 0 were listed previously among the unclassified nebular lines (*loc cit*), while 4076 22 was provisionally assigned to O II, although its intensity was much stronger than the intensities of other O II lines would lead one to expect, and consequently the identification was indicated as being doubtful Judging by the behaviour of the homologous lines in O II, 6717 should be weaker than 6731, and consequently its failure to appear is not surprising

It may be noted that all of the elements thus far found in the nebulæ, namely, hydrogen, helium, carbon, nitrogen, oxygen, and sulphur, are gases or have stable compounds that are gases at low temperatures

I S BOWEN

Norman Bridge Laboratory,
California Institute,
Pasadena

British Oyster Fisheries

By Dr J H ORTON

THE present depleted state of the British—and indeed also of most European—oyster fisheries, with the resultant scarcity of marketable oysters, is the main cause of the current high price of this delicacy The high value of the native oyster (*O edulis*) especially, has attracted attention to the probable values of old and neglected former oyster fisheries, and to the possibility of beginning new fisheries in localities where such have not previously existed Any attempt at improvement of our inshore fisheries may be welcomed, and particularly when directed towards the culture of sedentary animals, which promise more definite economic returns for effort expended than most other fisheries A broad view of the problems in oyster-culture should, however, be regarded as a necessary preliminary to all new schemes, for, as Hoek insisted, " Oyster culture *is* a culture and not a manufacture "

One of the chief difficulties in oyster culture is the fluctuation in the supply of small stock—which is the equivalent of raw material in a manufacturing trade On many English oyster beds recurrent periods of relative scarcity of small stock occur not infrequently, while at longer intervals great scarcity of all kinds of stock may occur The cause of these minor and major fluctuations has been in the past undoubtedly mainly the failure of the crops of young oysters for successively few or many seasons In a good season many millions of young oysters may be obtained, in contrast with a very small fraction of this number in a bad season One good season in about five would ordinarily be sufficient to maintain a bed in a flourishing condition, provided an adequate breeding stock be always maintained

The present scarcity of oysters on English oyster beds is due to several causes, of which the failure of good crops of young oysters since 1921 is probably the predominant one Other factors of importance in this regard are (1) an unusual mortality in the Thames Estuary area in 1920, (2) over fishing, and (3) the possible occurrence of increased pollution in inshore waters with a resultant lethal effect on larval and young oysters These matters, along with a consideration of enemies, pests, local effects of unfavourable weather conditions, in addition to the purely economic factors, need to be considered in ventures upon oyster culture

The condition of British oyster fisheries is, however, intimately related to that existing in Holland and France, since these countries have in the past furnished a source of cheap young oysters for stocking British grounds In France, depletion of the beds (of *O edulis*) has occurred contemporaneously with and from causes the same as or similar to those operating on British beds Conditions in Holland have recently been more favourable, but have resulted here also in fluctuating periods of relative scarcity Thus at the present time stocks of small oysters are low throughout western Europe Table I, however, shows that stocks of all kinds of oysters, as judged from statistical returns, are relatively low over

TABLE I —THE WORLD'S OYSTER PRODUCTION FOR 1912–1926[1] (*according to statistics*)

Country	Chief Species Cultivated	Unit of Quantity Stated in	Total Value in Most Recent Year	Production in 1926	1925	1924	1922	1920	1918	1914	1912
U S A	*O virginica*	1000 bushels[2]	$14 000 000			20,000				30 000[6]	
Canada	*O virginica*, *O lurida*	Barrels each =c 3 imperial bushels	$152 073	22 255	21 428	28 982	19 427	14 526	13 916	26,545	23 377
France	*O angulata*	Millions	francs 107,463 624[4]	*1083 7*	*889 7*	*660·4*	*439·6*	*378 4*	*546 2*	*692·6*	*1064 5*
France	*O edulis*	Millions	francs 6 565,580[4]	*10·87*	*7 98*	*29·28*	*208 1*	*463 3*	*414 1*	*739·7*	*944·6*
Holland (Zeeland Rivers)	*O edulis*	Millions	guilders 1,967,850	*17·07*	*18 23*	*24 85*	*27 54*	*36 37*	*41·65*	*30·35*	*45 13*
Zuider Zee	*O edulis*	Thousands				nil	13 6	953 0	421 0	8495 0	
England and Wales	*O edulis*	Millions	£101,480[5]	*15 86*	*16 74*	*16 97*	*23·67*	*39·44*			*33 39*
Ireland	*O edulis*	Thousands	£7,619	1 622	2 065	2 410	151	3 621	2 099	1 866	2 900
Scotland	*O edulis*	Thousands	£570	83	96	89	144	254		705	1 828
New Zealand	*O Angasi*	Bags, each = c 3 bushels	£19 479	27 828	26 039	23 796	27 280	26 703	22 827	24 798	
New Zealand	*O cucullata*	Bags, each = c 3 bushels	£8,344	6 771	8,297	6 841	7 323	6,797	10 422	8 361	7 728
N S Wales	*O Angasi*, *O cucullata*	Bags, each = c 3 bushels	£85 141			28 380	24 811	25,021	22 337	21 526	
Natal	*O cucullata*, *O prismatica?*	Dozens	£762	17 288	22 855	24 876	17 859	21 909	15 172	13 433	19 000
Japan	*O cucullata*, *O gigas*, *O denselamellosa*	Thousands of kwan[3] each = 8 267 lb or 3 75 kgm	yen 551,039	3 070	1,374	2 033	3 277	10 677	9,278	330	

[1] These statistics are given as stated in the various Government reports in the pre and post-War periods but as they relate to over lapping seasons are not all strictly comparable in the same year The figures for France relate only to the total output by oyster culture and those for England do not include the output from the Fal Estuary In each country the statistics are apparently comparable from year to year, and thus afford an index of the varying prosperity of the oyster industry in each region

[2] One bushel may contain any number of American oysters from 200 to 500 according to size

[3] One kwan = the weight of about 66 medium large English oysters

[4] Values for 1927 for respectively 1452 3 and 6·39 millions

[5] Value for 0 71 millions in 1927

[6] For the period 1911–1918

most parts of the world The true significance of these figures could be better estimated by comparison with a longer series, but nevertheless in themselves indicate the operation of some common factor or factors Of these factors, frequent failure of the young oyster crops and overfishing are probably the most important, with increasing pollution as a factor of least but possibly increasing importance

The occurrence of good crops of young oysters on English beds is closely correlated with warm summers, and on natural grounds there is little doubt that heavy falls of oyster spat are dependent directly or indirectly upon a more or less sustained temperature of the sea water at 60° to about 64° F or above In some seasons a good spatfall may be obtained, but even so, the yield of young oysters in the following spring may be slight, in other seasons, in spite of the demonstration of abundant larvæ in the waters over the beds, there may be little or a negligible spatfall It is advisable, therefore, to distinguish (a) the summer settlement of larvæ, as the spatfall, and (b) the product in the following spring, as the young oyster crop The best crops occur after long warm summers,[1] e g 1913, 1921, or from an early spatfall A complete scientific explanation of the factors concerned—which may be biological or purely biophysical—is still awaited, hence the need for prosecuting with vigour the investigations at Conway (referred to in NATURE, 123, 208) on the factors controlling spatfall and the survival of spat In the meantime, good crops of young oysters can only be expected on oyster beds either after long warm summers or when a warm period occurs in summer at about the time when a good proportion of the season's larvæ are ready to settle

Thus although researches on improved methods of spat-catching in the sea[2] may improve the oyster cultivator's probabilities of better crops, he is nevertheless dependent upon suitable weather, which is an unpredictable factor, for maintaining a succession of crops In this matter the steady production of millions of young oysters in artificial ponds at a cheap rate would immediately extend the possibility of oyster cultivation in Great Britain The English Fishery Department has already had considerable success in obtaining oyster crops in artificial tanks at Conway,[3] and it is suggested, could now attempt a *commercial* experiment on a grand scale, namely, prepare for and secure a crop of millions of young oysters, then, either sell the crop, or arrange to relay the product on existing oyster beds and cultivate them to a marketable size In the former case a demand sustained over a period of years would prove success, as would a satisfactory balance sheet in the latter In either case the Government might prove the value of its scheme empirically, before scientific assurance arrives

In the unusual mortality of oysters in the Thames Estuary in 1920, it was found impossible[4] to incriminate as the agent, trinitrotoluene, which had previously been dumped in this area in large quantities Nor was it possible to assign the mortality to any other lethal substance known to have been dumped in the sea in the post War epoch Thus the cause of the unusual mortality was necessarily left an open question it might have been due to unknown poisons, or to unrecognised parasitic disease The occurrence of heavy mortality in oysters at Taranto, Italy, in 1919, and on French beds, especially at Arcachon in 1920, renders it more likely that some parasitic organism was the common cause, though no suspicious parasitic form has yet been found As oysters are known to die from constitutional disorders brought on by extreme variations in external physical conditions, a determination of the cause of death in any given case is rarely possible The physiology of the oyster is thus extremely interesting from an academic as well as from an economic aspect For this reason—and others—it was strongly recommended[4] (1923) that a post graduate scholarship should be permanently founded for continuous researches on the physiology and biology of the oyster Such a scholarship was awarded to Dr C M Yonge for two years—and resulted in a valuable contribution to our knowledge of the physiology and anatomy of the oyster[5]—but has now unfortunately been allowed to lapse It may be again emphasised that the continuance of researches of this nature will add to our knowledge both of general biology and the special biology of the oyster in relation to culture

The effects of over fishing in the falling off of oyster production are, in the opinion of the writer, frequently underrated On a question of this kind, in which adequate scientific facts are not available, it is necessary to fall back on general principles One oyster can produce one million larvæ at a time, just as a codfish or a sea urchin may produce several million eggs, and it is often argued that quite a few individuals in a favourable season would be sufficient to produce a big stock of young The matter is important generally, and not merely confined to the oyster It is true that in extremely favourable circumstances a few individuals of one marine animal may produce a large population in the succeeding year or years, hence the view—especially held in oyster culture—that a stock may be reduced (over fished) to very small dimensions with impunity Fisheries in America, Australia, Scotland, and the German Bight have probably died out from acceptance of this doctrine It is, on the other hand, a generally accepted doctrine that the number of eggs produced per individual in a species is directly proportional to the probable rate of mortality before the attainment of full maturity, therefore when a stock is reduced to a few individuals, few young will survive, except in very favourable circumstances If such circumstances do not arise during the life of a surviving small stock, that stock will die out in that locality, whether it be oysters, sea urchins, sea-hares, ascidians, or other sedentary or semi sedentary forms, fishes—not being sedentary animals—fall in a different category

In order that a stock may be maintained in a certain locality, it would seem that a certain minimum number of individuals, which may be relatively large, is necessary It may reasonably be assumed that a fairly constant proportion of larvæ will

perish either from a multitude of enemies or unfavourable physical conditions, whether the total number be high or low; but if the number of larvæ be very low, there is a greater chance that all will perish. The conception that a minimum stock is necessary to maintain a species in a given locality thus arises. In the absence of any data on the problem, the economic limit of dredging has been suggested[1] as a practical minimum in the case of the oyster. The economic limit on the poorest English grounds works out at that state of the beds when about 50 to 100 adult oysters may be dredged per man per boat per day. With lower standards of living, or with very high prices, the economic limit may fall below this density. To-day the minimum stock necessary to ensure survival may therefore be estimated above rather than below the economic limit of dredging, as stated above, especially in localities where pollution is an increasing menace, since in the past the economic limit has not sufficed to ensure revival. In any event the careful cultivator will endeavour to maintain as large a stock as possible on the beds during the spawning season.

At the present day the spectre of pollution as a factor in diminishing or even preventing a spatfall, by destroying the larvæ, is probably in the background of the minds of most oyster producers. Oils are especially regarded with grave suspicion; but the small quantities of these substances relative to the volume of water with which they are mixed, and the small quantities of toxic ingredients in oils, renders it extremely doubtful that they alone can have any poisoning effect in *sea* water. There is, however, the broader aspect of general pollution to be considered. The additive effect of all the poisonous substances in the drains and sewers from industrial effluents especially—besides which tar and oils may be relatively unimportant—may be that of producing a very slightly unfavourable environment at first in a very small zone near the source of the effluent. This slightly unfavourable environment may be such as cannot be detected by any known method, and may result in forcing seawards the more delicate of the marine organisms. In many estuaries there can be no doubt, as Hautreaux (*Bull. Soc. de Géog. Comm. de Bordeaux*, II, 18, Bordeaux, 297, 455; 1895) long ago suggested, that the water oscillates up stream and down to a great extent as a result of the piston-like action of tidal waters outside;[6] the movements of shoals of estuarine crops of the jelly fish, *Aurelia*, for example, in the Hamoaze, Cornwall, and R. Blackwater, Essex, offer a simple means of observing this oscillation. Thus polluting substances or their products will tend to increase in such an oscillating body of water, especially between spring tides. Whether such a net pollution ever attains to lethal importance for the more delicate animals, such as oysters, in any particular locality is a legitimate subject for research, which, however, involves fundamental studies of the constitution of sea water. All coastal waters must be regarded as polluted—using the word in a general sense—in comparison with oceanic water, and the degrees of pollution of coast and estuarine waters may be more readily determined by comparison of their fundamental properties with the purer medium. The oyster cultivator will therefore welcome all schemes for the investigation of pollution and the maintenance of purity in estuarine waters.

Indeed, economic problems regarding oysters and oyster cultivation are so bound up with those in general biology that extensive co-ordinated researches prosecuted on the lines advocated in NATURE, **122**, p. 311, would serve both biological and economic aims, and might be the beginning of a new phase in British marine biological research.

On the economic side, it will be obvious from the account given above, and in NATURE, Feb. 9, that the oyster cultivator requires a long lease of the ground it is proposed to cultivate. Existing fishery rights must be acknowledged, and if necessary dredging rights of local fishermen may be accommodated by an allotment of shares in the new schemes.[7] In ventures in which the cultivator cannot expect to produce young oysters, that is, on purely fattening beds, State assistance cannot reasonably be expected. But where conditions are deemed favourable for the development of a new area for the production of young oysters, State aid in the early period of development may perhaps be reasonably asked for. In beginning a scheme for the production of oysters in a new locality, a fresh attempt is in fact being made to supply the raw material of an industry. In this respect oyster production is roughly analogous to beet production.

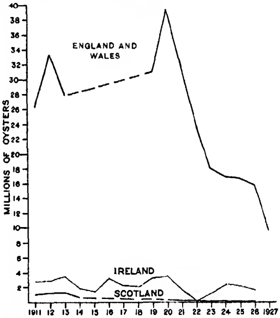

FIG. 1.—Output of oysters (mainly *O. edulis*) from oyster beds in the British Isles for the period 1911–27 (according to statistical returns). No records were kept in Great Britain during the European War.

New ventures which aim merely at fattening oysters will have to compete with well-established merchants, who on one hand are expert in their business, but on the other hand do not appear

to be able to meet the demand In new producing areas the essential characters of the grounds include

(1) Estuarine waters sufficiently enclosed—in a technical sense—to ensure the retention of the larvæ and spat in a maximum area under cultivation

(2) A local seasonal temperature range giving frequent probabilities of a maximum temperature in the bulk of the sea water of 64° F or more, and a minimum rarely below 34° F

(3) A large area of moderately clean ground, and moderately pure water which should not fluctuate greatly, nor fall much or often below 2 5 per cent, in saltness

(4) A sufficient stock of large oysters to supply probabilities of an increasing spatfall year by year

(5) A supply of cheap clean shell or other material for the annual sowing for spat

(6) Reasonable shelter from gales, if much sandy or fine gravelly ground occurs in the locality

(7) Immunity from gross sewage or industrial pollution now and in the fairly distant future

(8) Absence of an abnormal amount of enemies or pests

A review of these characters indicates that the southern regions of England and Ireland are most likely to yield new producing grounds, whilst a glance at Fig 1 suggests that potentialities for production in Ireland are undeveloped to a greater degree than in England

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Vibration in Bridge Structures[1]

BRIDGE building may be reckoned amongst the earliest of the structural engineers' efforts, and locomotive construction as one of the first lines of development in mechanical engineering, but the adequate study of the actions of a locomotive on a bridge has required very modern resources in investigation, and all those refinements of experimental and analytical methods that mark the engineering technique of to day The problem in its various aspects and complexities has been very completely studied, with the aid of these resources, by the special Bridge Stress Committee appointed by the Department of Scientific and Industrial Research in 1923 The Committee comprised highly representative scientific and technical engineers, under the chairmanship of Sir J A Ewing, of the University of Edinburgh, and the full report of their deliberations and investigations has now been published The remit of the Committee was "to conduct researches with reference to stresses in railway bridges, especially as regards the effects of moving loads" These comprehensive terms of reference have been very adequately interpreted, and the work of the Committee constitutes an invaluable study of the vibration of bridge structures under impact influences Work with a somewhat similar motive had previously been attempted—notably by the American Railway Engineering Association in 1910, and by a special committee of the Indian Railway Board in 1917—but the present report goes much further and deeper into the subject

The previous investigations had made fairly clear that the main cause of serious augmentation of bridge stresses arose from the unbalanced vertical forces developed by the locomotive Certain effects could be traced to rough and flat wheels, irregularities of track, or to heavily loaded freight cars, but these were usually small in relation to the direct consequence of the pulsating force—or 'hammer blow'—due to the 'balance' weights on the locomotive wheels While this was recognised, it has not been very effectively embodied in bridge stress rules, and, as in the well known Pencoyd formula, the influence of impact is generally covered by a proportionate increase, varying with span length, of the live load stress If impact is mainly due to locomotive actions, this process of making allowance on total live load is scarcely rational It is the achievement of the Bridge Stress Committee that it has not only clearly elucidated the nature and cause of impact, but that the investigation is so complete as to permit of the standardisation and rationalisation of impact allowances in general

An ordinary two cylinder locomotive is balanced by the locomotive engineer by the addition of weights to the rims of the driving wheels But this is merely a process of reducing the inertia force effects in the engine lines What is eliminated in those lines is transferred by the so called 'balance weights' to the vertical plane, and hence variation of horizontal force is changed to a vertical fluctuation giving rise to a pulsating force on the rails The magnitude of this force is all important The report repeatedly refers to it, and it is recorded that the locomotive engineers of Great Britain are prepared to limit its value to a total per locomotive of 12½ tons at 5 revolutions per second of the wheels It is, therefore, clear that the importance of the absolute value of this force as a factor in girder stresses is established and accepted The context also explains that, while in some centres special care is taken to test the balance of locomotives after construction, in other cases more attention is required in this matter It is also obvious that three- and four-cylinder, and electric locomotives, in which a much higher degree of balance is possible, have distinct advantages over the more common two cylinder type

The Committee's work consisted of the actual observation of bridge vibrations and the analysis

(*Continued on p* 463)

[1] Department of Scientific and Industrial Research Report of the Bridge Stress Committee Pp. vii + 215 (London H M Stationery Office, 1928.) 18s net.

Greenland as it is and as it was[1]

By Prof A C SEWARD, F R S

IT would not be inappropriate to take as a text for this lecture words borrowed, with a slight modification, from one of Thomas Hardy's novels "The past seizes upon us with its shadowy hand and holds us to listen to its tale" One of my aims is to recall a few scenes—in particular, one scene—from a past separated from the present by an interval measured in millions of years, and by so doing to illustrate an impressive contrast between what is and what was A comparison of a small area of Greenland as it appears to day with the same district as it was at a time roughly corresponding to the stage in geological history represented by the chalk cliffs of England, affords a startling proof of the changing face of the earth and illustrates the fascination and the stimulus inseparable from every honest endeavour to read the secrets of the rocks

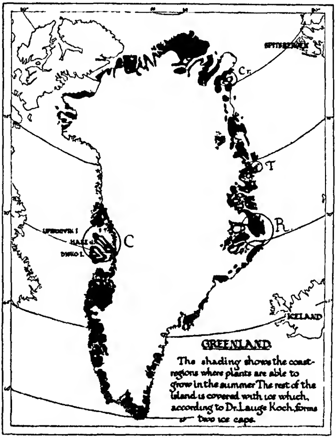

FIG 1—Greenland C, region where Cretaceous and Tertiary plant-bearing beds are exposed Cr locality where a few Lower Carboniferous plants have been collected, T, Sabine Island (Tertiary plants) R Rhætic plant-beds in the Scoresby Sound district

PHYSICAL AND GEOLOGICAL FEATURES

We will first look at Greenland as a whole Cape Farewell, the southern apex of the wedge shaped island, an island large enough to rank as a continent, is approximately on the same parallel as the southern part of the Shetland Islands and as Finland The broad base of the inverted triangle, the most northerly land in the world, reaches lat 83° N, the length is nearly 1700 miles and the breadth in the middle is rather more than 600 miles Greenland is a relatively stable land, one of the oldest pieces of the earth's crust severed from an inconceivably ancient continent which once united the west and the east By far the greater part of the island consists of crystalline rocks of the type we see in the Norwegian mountains and in the north west Highlands of Scotland In the course of ages, Greenland rose and sank with recurrent pulsations of the crust, but the movement was comparatively slight, the sea only partially transgressed the land and advanced farther towards the feet of the mountains

Of these oscillations there is evidence in sandstones and other sedimentary rocks which at several places on the coastal fringe lie on the eroded platform of the original foundations The cliffs of Washington Land on the north-west coast are rich

[1] Friday evening discourse delivered at the Royal Institution on Jan 25

in marine fossils, in places the abundance of corals led the Danish geologist Lauge Koch to describe them as veritable 'coral reefs' Near the north east corner of Greenland some fossil plants were found in sediments deposited in the early days of the Carboniferous period Farther south, at Sabine Island, other sedimentary rocks have yielded impressions of leaves scarcely distinguishable from those of the existing maidenhair tree (*Ginkgo biloba*), with fragments of other plants of Tertiary age Still farther south in the district of Scoresby Sound a rich Rhætic flora has been discovered, a flora no less luxuriant than floras of the same age from much more southern countries The plant fragments were transported by rivers turbid with sand and mud to a delta encroaching over the waters of an estuary at a period between that represented by the still older Triassic salt bearing marls of Cheshire and the younger Jurassic strata exposed on the Yorkshire coast There are also more ancient sedimentary rocks not far from Cape Farewell Special attention will be given in the latter part of the lecture to the remains of a vegetation scattered through sandstones and shales deposited in an estuary during the first half of the Cretaceous period and now accessible in the cliffs of Disko Island, Upernivik Island, and the mainland about half way up the west coast This flora is selected in illustration of the contrast between the present and the past to which reference has already been made

The solid land is seldom stationary, we think of it as permanent, but intensive study of most regions demonstrates the fallacy of conclusions drawn from general impressions Observations made over a series of years in the latter part of last century show that a section of the west coast is now sinking, the brown seaweeds are slowly creeping up the face of the cliffs The Cretaceous plant bearing beds are occasionally overlain by strata of Tertiary age, some of which are rich in plants Both Cretaceous and Tertiary rocks are protected by superposed layers of basaltic lava and volcanic ash—Arctic outliers of the great volcanic plateau of which there are other relics in the Giants Causeway and on islands off the west coast of Scotland Such are some of the documents, differing widely in geological age, which tell of recurrent changes of level and supply the means of interpreting the 'ghostly language of the ancient earth"

A word on the human inhabitants there are about 20,000 Eskimo, most of whom live on the west coast There is a fairly large colony a short distance from Cape Farewell on the east coast, and in 1925 one or two new settlements were established in the neighbourhood of Scoresby Sound. More than 900 years ago, Eric the Red, taking with him about a hundred companions, with sheep and oxen, sailed from Iceland and founded colonies near the south end of the west coast of Greenland In 1721 Hans Egede sailed from Bergen and accomplished what has been called the re colonisation of Greenland, he went there as a missionary in the hope of finding some descendants of the earlier Norse colonists, he found only graves and ruined buildings In recent years many other traces of the early settlers have been discovered by Danish antiquarians In addition to the Eskimo there are a few Danish officials Under Danish rule the condition of the natives has been greatly improved, they can now obtain the necessaries of life whether hunting is good or bad Dogs used for drawing sledges in the northern half of the country are important and, indeed, essential companions to the inhabitants, in summer they are usually left to fend for themselves, in winter they become efficient servants

Greenland under an Ice Sheet

The outstanding feature of Greenland is the inland ice With the exception of a coastal strip along most of the west coast, a relatively broad strip on the extreme north, and a narrow margin on the east, the whole of the island is hidden under ice of unknown thickness which forms a gently sloping dome rising in the interior to a height of at least 9000 ft Here and there on the lower slopes of the ice sheet, summits of mountains project as solitary islands above the "waste of frozen billows" These are spoken of as 'nunataks,' a name suggested by Nordenskjold Sailing up the west coast in summer, one sees the ice free edge of a plateau rising to a height of a few thousand feet, the cliffs intersected by many tortuous fiords, and, on the seaward side, groups of rocky islands with the rounded contours characteristic of ice action An occasional white gleam above the dark cliffs of the mainland comes from the edge of the inland ice Some glaciers creep into the open sea, others enter the deep water of fiords several miles from the coast From one glacier at the head of the ice fiord near Jakobshavn (lat 69° N) are calved many of the icebergs which are carried by currents to the Newfoundland banks and much farther south, many are stranded on shallows off the Greenland coast Near the land the sea is littered with icebergs of all shapes and sizes, their sunlit sides and pinnacled summits are radiantly white, and near the surface of the water a brilliant blue green In the stillness of the night

the sudden booming of breaking bergs recalls Coleridge's description in "The Ancient Mariner" "the ice did split with a thunder fit" Some of the larger icebergs reach a height of 200 ft above the water, and the submerged portion is approximately eight times as deep as the height of the visible berg

The jagged Alpine peaks of the higher mountains of crystalline rock, which are especially impressive as seen off Upernivik Island, are in marked contrast to the flat topped basaltic hills of Disko Island and the adjacent Nugsuak Peninsula (Fig 2) Before passing to the consideration of the fossils preserved in the sediments below the basalt, we will take a general view of the vegetation which partially clothes the ice free coastal belt

FIG 2 Basalt-capped hills of the Nugsuak Peninsula seen from Disko Island (Photo by R E Holttum)

THE PRESENT VEGETATION OF GREENLAND

From the whole of Greenland, 390 species of vascular plants, that is, flowering plants, conifers, and members of the class to which the ferns belong, have been recorded The tree limit, which is taken as the southern boundary of Arctic vegetation, is close to Cape Farewell, in south Greenland there are birches, alders, and a few other trees, some reaching a height of 12 ft or 18 ft Farther north in the region of Disko Island, the only representatives of trees are dwarf shrubby willows and the dwarf birch, the tallest willows rarely exceed three feet The prostrate shoots bear an amazing number of catkins, their roots spread far in a horizontal direction through the shallow soil (Fig 3) The ground is permanently frozen at a depth of rather more than a yard A reflection of the severity of the life conditions is seen in the internal structure of a willow stem, in a section of a stem less than an inch in diameter fifty rings were counted Lichens play a prominent part in the landscape and in preparing the ground for higher plants, tufts of white, yellow, and grey, with splashes of vermilion, give colour to tundra and rock It is worthy of note that about half of the lichens obtained from the Antarctic continent belong to species recorded also from Arctic lands, these wind borne plants are probably the greatest travellers of the plant kingdom The green ribbons marking the course of streams owe much of their brilliance to mosses

There are a few ferns, some growing in rock fissures, some in company with flowering plants in favoured situations *Cystopteris fragilis*, the brittle fern, is one of the most cosmopolitan of plants, it grows in Spitsbergen, in Chile, Abyssinia, on Kilimanjaro, and in the sub Antarctic island of South Georgia There is also the holly fern *Polystichum Lonchitis*, a European species which flourishes in central Asia and in the southern hemisphere Reference may be made to two other plants which belong to the fern class and are very widely distributed *Equisetum arvense*, the common horse tail, and a club moss, *Lycopodium Selago*

Turning to the flowering plants, which give to the Arctic landscape an unexpected brightness, a few examples must suffice The Monocotyledons include several grasses, sedges, and rushes, species of pondweeds (*Potamogeton*) and a few forms of cotton grass (*Eriophorum*) On a sunny slope on the shore of Disko Island there are a few orchids (*Habenaria* and *Listera*) and other plants which have been able

to occupy this exceptionally favoured station many miles north of their normal range The tallest flowering plant is *Archangelica*, an Umbelliferous genus prized as a delicacy both by the Eskimo and sophisticated Europeans The large rounded leaves of an *Alchemilla*, closely allied to the British lady's mantle, come next in size to those of *Archangelica*

There is much heath land, but the heather and ling which we associate with heath moors are absent, their place is taken by *Cassiope tetragona*, characterised by the grooved leaves in four crowded ranks and yellow flower bells *Cassiope* grows in Scan-

FIG 3 —Willows and other plants on a delta below the cliffs of the Nugsuak Peninsula (Photo by R E Holttum)

dinavia, though not elsewhere in Europe, in the Rocky Mountains, and in central Asia The crowberry, *Empetrum nigrum*, associated with the bilberry, is a common Arctic plant which has wandered as far as the southern end of South America Saxifrages are abundant, the flowers of the purple saxifrage, *Saxifraga oppositifolia*, are an exception to the prevailing white This species, one of many common to Greenland and Britain, occurs with other plants on the north coast of Greenland up to lat 83° N, it grows also on the higher slopes of the Himalayas *Dryas integrifolia*, an American species differing but little from the British *Dryas octopetala*, is a conspicuous member of the west coast flora *Dryas octopetala* is characteristic of the north coast and eastern Greenland The familiar and always attractive hare bell, *Campanula rotundifolia*, seems to be as much at home on the hills of Greenland as it is in England, in North Africa, and the Far East Among other plants are the mountain sorrel *Oxyria digyna*, the moss campion, *Silene acaulis*, which is one of several cushion plants characteristic of rocky places, a closely allied plant, *Melandrium apetalum* (or *Lychnis apetala*), the yellow poppy, a species of *Pyrola* (the Labrador tea), *Ledum*, with its white sweet scented flower heads, exceptional in a flora composed almost entirely of scentless flowers, also a willow herb with flowers larger and handsomer than those of our British species

My main object is to give a general impression of the more obvious features of the present vegetation, not to describe many individual plants A Scottish mountain with many immigrants from Arctic lands reproduces in broad features the Greenland landscape, but there is this difference the mountain flora in Greenland reaches the coast and there is no intervening belt of forest and meadow The mean temperature for July in lat 69° N on the west coast of Greenland is 47° F, the corresponding temperature in the London district is 60° F, in February the mean temperature in Greenland is 36° below freezing point, in London it is 10° above the freezing point It is not until the temperature rises above the freezing point that the plant world becomes active in the extreme north the growing season lasts barely two months, it is only in July that rain takes the place of snow In the region of Disko Island the summer season is not much longer The summer is a period of concentrated effort, there is no time for the leisurely sequence of plants that bloom early and plants that bloom late The unfolding of buds prepared in the previous year before the incidence of the winter sleep heralds the rush of new life with an almost explosive suddenness Short

as the summer is, the plants succeed in spreading a parti coloured carpet over hill slopes and valley, and in decorating rock ledges and fissures A brilliant summer display is followed by a "rich autumnal melancholy" the ground is strewn with deep red and orange yellow leaves which are soon to form a welcome blanket, aided by the snow which quickly follows, above the shoots entering on the long winter's rest

Of the 390 vascular plants, Prof Ostenfeld of Copenhagen thinks that about 13 per cent may have been introduced by the early Norse colonists, of the remainder, by far the greater number came from North America by way of the narrow channels separating the American archipelago from the north west corner of Greenland A smaller number travelled from Europe, some driven by wind, the passage probably facilitated by a frozen sea, others carried by birds

Greenland as it is enables us to picture the British Isles in the grip of the Ice Age, at a time separated from the present by a comparatively short interval as geologists reckon time—say 40,000 years We know that the flora of Britain, as also that of northern Europe generally, was much richer in Arctic forms than it is now To give one example from thin layers of peaty material in a gravel pit close to Cambridge, several Arctic species associated with more southern types have been identified, a mixture very similar to that in the present Greenland flora When the Glacial period was at its height, the conditions in Greenland were even more severe than they are now, it is believed by some botanists that the whole of the vegetation colonised the land after the Ice Age had passed its climax The entire vegetation, it is suggested, must have been destroyed On the other hand, the occurrence of flowering plants on the northern border of Greenland and of some species on wind swept island peaks above the level of the inland ice, gives support to Prof Ostenfeld's view that a small proportion of the present flora survived the great ordeal It is highly probable that, as in Greenland to day, a comparatively rich flora is able to exist on the ice free margins and on nunataks, so also when the British Isles were as Greenland is now, there must have been sheltered places which served as refuges for the hardier member of the pre glacial vegetation

Many Greenland plants have a circumpolar distribution, some are exclusively or mainly Arctic, others, though widely spread in Arctic regions, are established also in more southern stations A southern migration from the far north was caused by the gradual extension of the ice, the majority of the plants, unable to endure the increasing hardships, were driven to alien lands and a few crossed the equator When the ice retreated and the temperature rose, some of the travellers returned to the north, others found congenial habitats in the colder climate on mountain slopes A few of the Arctic plants held on to life in their original homes as a small nucleus company in sole possession of a territory temporarily deserted by most of the former occupants

We have noticed the circumpolar range of many members of Arctic floras, and we have seen that some species are able to exist even on the northernmost edge of Greenland which looks out over the abysmal Polar sea Turning to the Antarctic continent, we find an amazing contrast flowering plants are unrepresented on the great mass of land surrounding the South Pole, even though its coast line occupies a position where in the northern hemisphere there is a comparatively rich flora Two flowering plants have been found south of lat 60° S, in South Georgia (corresponding roughly in latitude with the British Isles), the South Shetlands, and Graham Land

THE CRETACEOUS VEGETATION OF WESTERN GREENLAND

We will now visit the cliffs and ravines of Disko Island, Upernivik Island, and the adjacent main land, and glance at some of the fragmentary samples of the Cretaceous flora embedded in the mud and sand of an old river delta We pass over the ages intervening between the maximum glaciation during the Ice Age, which antedates the present by some 40,000 years, to the early days of the Cretaceous period, separated from us by perhaps a hundred million years Among the fossil ferns, by far the most abundant genus is *Gleichenia*, or *Gleichenites*—to use the name generally applied to extinct species Many of the fronds are fertile, and it is possible to examine under the microscope the structure of the spore capsules The habit of the leaves and the structure of leaf stalks and sporangia afford convincing evidence of close relationship with species of *Gleichenia* which are now among the more familiar ferns in the tropics *Gleichenia* is unknown in Europe Another type of fern (*Laccopteris*) is represented by fronds characterised by spreading finger like branches set with long and narrow leaflets which agree closely with those of the Malayan genus *Matonia* Similarly, a few specimens have been obtained which present a striking resemblance, in form and venation, to fronds of another Malayan and Indian genus, *Dipteris*, a plant described by

Alfred Russel Wallace as growing, in company with *Matonia*, on the higher slopes of Mount Ophir in the Malay Peninsula

Leaves, twigs, and occasional petrified stems of conifers are fairly common To-day there are no conifers in Greenland north of lat 67° 50′ N, the northernmost limit of the juniper Petrified stems of conifers rival in size the trunk of a well grown fir, and the annual rings, in marked contrast to those in the dwarfed stem of an Arctic willow, are comparable in breadth with the rings in an English tree Some conifers are represented by innumerable fallen leaves recalling the leaf carpet in a modern forest Imperfectly preserved leaves are untrustworthy as criteria of precise affinity, but such characters as can be made out suggest relationship with the umbrella pine (*Sciadopitys*) of Japan Twigs and occasional cones bear testimony to the occurrence in the Greenland forests of trees akin to the redwoods and mammoth trees which are now restricted to a narrow territory in California Other conifers resemble cypresses, and there is some evidence of the presence of trees allied to existing Araucarias

Two other groups of naked seeded plants (Gymnosperms) are represented broad, wedge shaped leaves with the blade cleft into two or more segments differ in no essential respect from the foliage of the maidenhair tree, the solitary survivor, and that only through the care of man, of a class which once overspread the world The second group is the Cycadophyta, another branch of the plant kingdom which for long ages, in the Mesozoic era, was one of the ruling dynasties and is now represented by a comparatively small family, the cycads or sago palms, which are mainly tropical and reach their northern limit in Florida It is unlikely that the Cretaceous fossil fronds, despite their general similarity to those of living genera, were borne by plants closely related to the true cycads, they probably belonged to species of a wholly extinct section of the group

Finally, we come to the flowering plants the Cretaceous representatives of the class which is now dominant in the plant kingdom were trees, not low growing shrubs or perennial herbs By far the commonest tree or at least the tree which has left the most abundant traces, seems to have been the plane, represented by several forms It must be remembered that the available material, largely consisting of detached leaves, is a small collection of scraps, a random choice of the winds which swept broken twigs and leaves into the waters of a river carrying to its delta a burden of sediment and vegetable debris, records destined to serve as a source book for historians of a future age Our conclusions are based on scraps of evidence, and the only plants we know are such as came within the reach of the agents which caused their preservation In form, in venation, and in size, the leaves of the Greenland planes are scarcely distinguishable from those of trees now living in Mexico, in Greece, and Asia Minor A type of leaf that is abundant at certain localities was for many years believed to belong to a tree nearly related to the tulip tree (*Liriodendron*) of North America and China [2] The examination of more recently collected specimens has confirmed a previously expressed suspicion that the supposed *Liriodendron* leaves are not complete leaves but leaflets from the foliage of trees nearly related to the tropical genus *Dalbergia*, a member of the Leguminosæ Some years ago the late Prof Nathorst of Stockholm described specimens of large leaves and pieces of inflorescence presenting an unmistakable resemblance to the leaves and flowers of *Artocarpus*, the tropical bread fruit tree Some smaller examples of the same type were collected in 1921 The Cretaceous vegetation included other broad leaved trees magnolia, oak, trees related to members of the Laurel family and to species of the family Menispermaceæ now mainly tropical in distribution

It is possible with the help of a little imagination to reconstruct a scene in Cretaceous Greenland Across a broad estuary in summer, a range of mountains on which patches of winter snow are still unmelted, in the foreground maidenhair trees, conifers foreshadowing pines, cypresses, araucarias, and other surviving members of the Gymnosperms There are also many ferns, a few with erect stems, many with creeping rhizomes bearing long stalked and repeatedly forked fronds, others with leaves divided into long, narrow arms Among the broad leaved trees are several planes, an oak, a magnolia in flower, trees with the foliage of dalbergias, the cinnamon, and trees belonging to families which since the Cretaceous period have wandered through Europe and the greater part of the North American continent, some surviving only in the southern tropics

Fossil Plants as Evidence of Climatic Change

An uncritical or superficial comparison of the Cretaceous vegetation with that in the Arctic regions at the present day would seem to necessitate

[2] In a book "A Summer in Greenland," published by the Cambridge University Press in 1922 I referred to these leaves as *Liriodendron* this mistake was corrected in the description of the Cretaceous flora published in the *Philosophical Transactions of the Royal Society* in 1926

the inference that the Cretaceous climate must have been tropical Some of the ferns and other plants obtained from the Greenland rocks have been compared with species that are now mainly tropical in distribution Let us consider more closely the evidence and the conclusions which may legitimately be drawn from it It is true that the existing species of the fern *Gleichenia* are for the most part tropical, on the other hand, the genus occurs in the Far East north of lat 30° N and extends a short distance north of lat 20° N in North America Moreover, the occurrence of species at an altitude of more than 12,000 ft in New Guinea and above 10,000 ft on Ruwenzori in tropical Africa shows that the genus is able to tolerate conditions that are by no means tropical

One of the most remarkable instances of the presence in the Cretaceous flora of a plant that is now tropical is furnished by *Artocarpus* (Fig 4) The genus *Dalbergia* affords an almost equally striking contrast in geographical range The present distribution of *Magnolia* in both the Old and New Worlds is far to the south of its former range The plane tree (*Platanus*) now flourishes in temperate regions, in Greece and Asia Minor, and in America it passes north of lat 40° N The genus *Ginkgo* flowers freely in the south of France, in England it is comparatively hardy The present geographical distribution of such Greenland Cretaceous genera as are now represented by existing species would seem to indicate a climate in the Arctic regions not less genial than that in southern Europe at the present day The important point is the value to be attached to this kind of comparison We know that closely allied species often grow in regions differing considerably in mean temperature

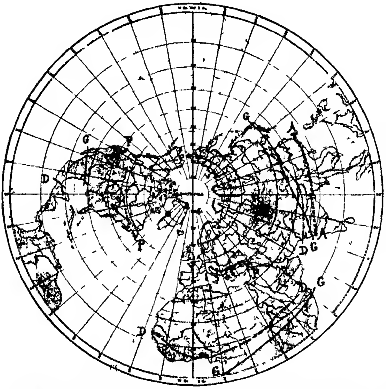

Fig 4 —Map showing the approximate northern boundary of the area of distribution of living species of the following genera A, *Artocarpus* D *Dalbergia* G *Gleichenia*, P *Platanus*

A further point is, ought we to assume that plants have remained unaltered in their constitution, in the sensitiveness of their living protoplasm, to the effects of cold and other external influences? It is surely rash to assume that in the course of ages there has been no change in the degree of response to factors which govern existence My own view is that the practice of employing plants, especially extinct plants, as guides to temperature in the past, has been carried too far There can be no doubt that, when the Cretaceous vegetation covered the western glens of Greenland, the climate must have been very much more genial than it is now, we cannot usefully attempt to estimate the difference in degrees of temperature How can the difference be explained? The often repeated proposal to assume movements in the position of the earth's axis—a shifting of the poles—even were there adequate grounds for the assumption, would not provide a satisfactory solution Astronomers offer no encouragement to geologists prepared to take liberties with the axis of the earth It is certain that the boundaries of land and sea, the height of the land as well as the area, have changed from age to age and that climatic conditions have correspondingly fluctuated Changes in the relative position of land and water, such as we can legitimately postulate, would go some way towards provision of the environment demanded by the Cretaceous vegetation, but it is the opinion of some meteorologists that we cannot solve the problem on these lines

The publication of Wegener's views on continental

drift, the shifting of continental masses by the slow drifting apart of slabs of land detached from a once continuous surface, seemed to offer a possible way out of the difficulty created by the occurrence of fossils in places where their presence has long been a puzzle to geologists We may hope before long to have trustworthy data by which to test the value of Wegener's hypothesis It is tempting to imagine Cretaceous Greenland lying many degrees south of its present position The close correspondence between the Rhætic flora obtained from Scoresby Sound and that discovered some years ago in southern Sweden, and a similar agreement between the Arctic flora and floras preserved in rocks of the same age in Maryland and Virginia, in Bohemia, and elsewhere, almost persuade us that we are most likely to solve the problem by regarding the earth's crust as a collection of blocks floating on a heavier substratum, some of which have wandered far from the positions they once occupied Evidence in support of changing climates is as strong as evidence can be, but we are still groping for satisfying explanations It may be that no explanation can be found unless we adopt the Wegener hypothesis or some modification of it

On the other hand, it is difficult to believe that the greater part of Greenland in the Cretaceous period was not, as it is now, well within the Arctic circle Until we have convincing evidence of drifting continents, the question of how the problem of climatic change is to be solved must be left unanswered Assuming an Arctic Cretaceous Greenland, it follows that the luxuriant vegetation must have been able both to lie dormant during the long winter night and to accomplish the miracle of reclothing the earth in the course of the short summer aided by an ever present sun This unavoidable conclusion, though difficult to accept, is perhaps not beyond the range of possibility

Though we leave unsolved problems raised by the contrast which it has been my aim to illustrate, we have obtained an insight into the methods of deciphering the records of the rocks, records which enable us to reconstruct some of the sharply contrasted stages in the history of an ever changing world

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of the records therein obtained The gross total of the work in the field and in the office is enormous, but the subsidiary work called for in the study of vibration instruments and their accuracy, special small scale laboratory tests, the development of a bridge-oscillating machine, and the theoretical investigation of bridge vibrations, are all of considerable scope and important in themselves Indeed, the analytical work of Prof Inglis is already well known as a research of special distinction, but although it had been, in the main, separately and previously published in special papers, its function in guiding the investigation is only now clearly seen through its relation to the complete report

The pulsating forces from the locomotive wheels create regular impulses on the structure during passage If these are in agreement with the natural frequency of the bridge, large vibratory amplitudes may ensue as a result of resonance The work of investigation, then, entailed the measurement of natural frequencies with the bridge loaded and unloaded, and the observation and recording of the deflections with the locomotive passing over, first at very low speeds, and then at speeds at and around resonance Examinations were carried out on 52 bridges varying in span from 16 ft to 345 ft The locomotives were provided by the railway companies, who throughout co operated with the Committee All types were represented In many cases the engines were specially chosen for the large hammer blow which they developed, so that the worst possible conditions could be fully observed The total amount of information gathered, and the wide range of spans dealt with, full particulars of which are given, certainly permit of important conclusions which should prove thoroughly reliable in the guidance of bridge design

The limitation of the amplitude of vibration in any case is partly an effect of damping, and in this connexion the interesting work on the influence of the locomotive springs should be noticed There is apparently a pair of critical speeds depending on whether the suspension springs are in play or not, the probability depending on whether the oscillations of the bridge are sufficiently great to overcome the spring friction Apart from damping, however, the span length is an all important factor With short spans the natural frequency is too high to be equalled by the locomotive speeds With very long spans, on the other hand, the natural frequency agrees with low locomotive speeds, when the impulses are relatively small To deal with these different effects the Committee develops a 'dynamic magnifier,' a multiplier akin to the usual amplification factor of vibration theory, which expresses the ratio of the vibration amplitude to the deflection that would be caused by a static load equal to the hammer blow This factor is first developed for the synchronous condition for all spans and then corrected for the interrelations of span length and locomotive frequency It would appear that spans around 100 ft are subject to the largest dynamical magnification The curve for this important factor should ultimately take an important place in bridge design rules

The report briefly discusses other causes of impact, such as effects of irregularities of track, rail joints, and the 'lurching' of locomotives, and enters at large into the tabulation of loads and allowances for impact Appendixes on impact formulæ, instruments, balancing of locomotives, etc, are given The whole report constitutes an impressive compilation of the details and conclusions of a courageous and exhaustive full scale research that reflects great credit on the Committee and its staff

Obituary

THE issue of the *Physikalische Zeitschrift* for Jan 1 contains a photograph and an obituary notice of Prof A H Bucherer of Bonn, who died in May 1927, written by his former colleague, Dr R Tomaschek He was born in Cologne on July 9, 1863, the eldest of six children of H Bucherer, a chemical manufacturer, and his wife, a musical and highly educated English lady He was educated at the Cologne High School, where he displayed a gift for languages After serving his year in the army and spending a year at the Hanover technical school, he went in 1885 to the Johns Hopkins University, Baltimore, where he studied under Prof Ira Remson, and for a time held a lectureship, then in 1893 to Cornell University, and in 1895 returned to Germany to complete his studies under Prof Braun at Strasbourg, and took his doctor's degree in 1896 After a further three years at Leipzig under Ostwald, and at other universities, he became a lecturer on physical chemistry at Bonn in 1899 Later he became honorary professor, a post he resigned in 1923 From his youth he showed himself of independent thought, little disposed to conciliate those from whom he differed, and this attitude did not smooth his way in life He is best known for his "deformable electron" and for his experimental determination of the influence of the speed of an electron on its apparent mass He was not satisfied with Einstein's relativity theories, and was engaged towards the end of his life in an endeavour to deduce all the results of that theory and remove some of the difficulties it has raised, by a logical development of classical mechanics

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BY the recent death of Dr Franz Oppenheim, announced in the *Chemiker Zeitung*, Germany has lost one of its leading personalities in chemical industry For nearly fifty years Dr Oppenheim was associated with the Aktiengesellschaft für Anilinfabrikation in Berlin, of which concern he was president at the time of its inclusion in the I G Farbenindustrie Aktiengesellschaft in 1925 His ripe experience led to his appointment on the board of management of the latter amalgamation He held several public offices connected with the German chemical industry, for example, he was treasurer of the Emil Fischer Society for the promotion of

chemical research, of the Adolph von Baeyer Society for the promotion of chemical literature, and of the Justus von Liebig Society for the promotion of chemical teaching Quite recently he had been elected to the committee of the Chemisch Technische Reichsanstalt in Berlin He died at Cairo at the age of seventy seven years

The death on Feb 28, at the age of seventy three years, of Dr J Wells, formerly Warden of Wadham College and Vice Chancellor of the University of Oxford, is felt as a serious loss in many departments of University activity Though not himself a student of science, he was never unmindful of the scientific traditions of the College over which he presided It is undoubtedly the case that but for his wise and fair minded dealing with the matter during his vice-chancellorship, the Lewis Evans collection of scientific instruments might have been lost, not only to Oxford, but to England as well It should always be remembered that not only this invaluable asset for the history of science, but also many other advances in the scientific equipment of the University of Oxford, owe their efficiency, if not their existence, to the good offices of Dr Wells

News and Views.

The fiftieth birthday of Prof A Einstein occurred on Mar 14 and brought congratulations from all parts of the world The German Chancellor hailed him as "Germany's great savant," and the Berlin municipality gave him the life tenancy of a pleasantly situated mansion The University of Paris conferred an honorary degree The Zionists are to plant an "Einstein Wood" near Jerusalem Never before has the name of a scientific worker meant so much to the average man Yet the creator of relativity and of the unitary field theory remains a quiet and retiring personality who dislikes publicity and society His appearance suggests a musician, and indeed his love of music is one of his leading characteristics Last year he gave a violin recital for a charity He finds much pleasure in Russian literature, and appreciates modern ideas in architecture He is an ardent sympathiser with efforts for world peace Recently his health has not been good, but he says, "Illness has its advantage one learns to think I have only just begun to think"

Employers and trade unionists associated under the auspices of the Conference on Industrial Reorganisation and Industrial Relations have recently issued an interim joint report on unemployment In this report the problem of unemployment is investigated and suggestions made for its diminution It is pointed out that, since 1920, there have seldom been fewer than a million workers unemployed in Great Britain, while at times the number has exceeded two millions The heavy industries in particular have been severely hit by the depression and the activity of certain prosperous industries, such as artificial silk and the motor industry, has not really compensated for this depression in the great basic industries The report stresses three factors, monetary policy, world economic conditions, and the temporary displacement of labour due to the rapid adoption of labour saving methods, as being the main causes of the present acute unemployment.

Corresponding to this analysis of the causes of unemployment in Great Britain, the main remedies (that is, apart from immediate or merely palliative measures) suggested in the recent interim report are *first*, an inquiry into monetary policy with whatever action may be found necessary, *second*, the reorganisation of industry, including rational organisation into larger units and the substitution of modern plant and technique, and *third*, measures to mitigate the evils resulting from rapid displacement of labour Finally, the novel and interesting suggestion is put forward that a Labour Reserve Fund should be set up either by firms or by particular industries, which fund would be available for the purpose of assisting displaced labour Progressive firms, it is pointed out, build up special reserve funds (apart from normal depreciation) to enable plant to be replaced before it is worn out, so that the most modern equipment can be introduced It is even more necessary that such progress should not involve hardship to the human element

Industrialism in England moves on apace and the town continues to swallow up the countryside This is a healthy economic sign even though it leads to unhealthy social conditions The old order of towns and villages is giving place to new groups of towns or 'conurbations' and regional associations Mr F Longstreth Thompson in his address on 'Recent Developments in Town Planning,' read at the Surveyors' Institution on Mar 4, enumerates no fewer than 67 joint committees covering a total area of almost 12,000,000 acres and having a population of approximately 30,000,000—out of a total population for England and Wales of only 38,000,000 In view of the near approach of the next census, this raises a question of great importance Hitherto the statistical information has been given separately for the towns, the urban and the rural districts This assumes an economic isolation which no longer exists, and serious consideration should be given to furnishing returns on the basis of these new divisions which have developed by and from the recognition of mutual dependence and interests For the sake of continuity it may be essential to maintain the earlier census divisions, but supplementary summaries may at least be possible

Returning to Mr Thompson's paper, he points out two useful outgrowths from the original Town Planning Act For the moment, town planning schemes are confined to land which is in course of development or appears likely to be used for building purposes For boroughs and urban districts with a population

of more than 20,000, such schemes are obligatory, though the date of their completion has been twice postponed The fact that other communities have organised themselves voluntarily for the preparation of a scheme shows that regional and town planning is now accepted as part of local administration The latest developments have been in the direction of controlling areas already built upon The Minister of Health now has powers to act with the view of preserving the existing character and protecting the existing features of any locality of special architectural, historic, or artistic interest Advantage has already been taken of this permission to prepare schemes for Oxford, Winchester, Exeter, and Canterbury Mr Thompson notes also that official consideration is being given to the question of extending town planning powers in respect of all built on areas and that it may be anticipated that the scope of the Act will be enlarged in this sense in the not distant future

AT the time of writing no detailed account has appeared of the circumstances attending the commencement of the disastrous floods that began on Mar 13 in Alabama, U S A, owing doubtless to the speedy interruption of communications between the devastated area and the outside world In the *Weekly Weather and Crop Bulletin* of the U S A Department of Agriculture, it is stated that in January a large part of the States northwards and northwestwards from the Ohio and Missouri valleys had extreme cold, with heavy snowfall, which in some places exceeded anything known before in January The rainfall over Alabama for that month was, however, not remarkable In February there was an equally pronounced area of cold, rather farther south than that of January, the distribution of excessive precipitation was different and covered a smaller proportion of the country, Alabama lying, however, well within the most notable wet region, which included the Atlantic coastal States and extended south westwards to the Lower Mississippi River Within this wet zone the fall was sometimes more than twice the normal for the month The same publication contains a note of excessively heavy rains over parts of Alabama early in the present month, and of the rivers Tombigbee and Coosa being in flood before the end of the first week

MORE recent meteorological information is available on the charts for the northern hemisphere published by the Meteorological Office, London Between Mar 10 and 12, a large anticyclone moved eastwards from a position south of the Great Lakes A long chain of depressions which extended from Alaska southwards to the western part of the Gulf of Mexico, if not still farther, began to replace the anticyclone and brought wet weather with southerly winds and rising temperatures to the Gulf States Cyclonic weather appears to have continued at least up to Mar 16, that is to say, for three days beyond the date when the floods are reported to have begun The southerly winds evidently extended from regions well within the tropics, and must have been heavily charged with moisture It is reasonable to suppose that the work of the tropical rainstorms may have been aided by rapid melting of the snow on high ground farther north, and that the overcharged rivers burst their banks or 'levees,' as happened in the Mississippi floods of 1926–27 Such disasters, and the more frequent devastations on a smaller scale due to travelling 'tornadoes,' are inevitable in a country where the gradient of temperature with latitude in early spring is so steep It is the presence of the tempering waters of the North Atlantic in high latitudes that saves the British Isles from like visitations

SEVERAL of the Livery Companies of the City of London have made very substantial provision for the development of science and technical education, and it is estimated that the amount actually expended by them on these objects exceeds two million pounds Some of the companies have established scholarships or fellowships, in addition to making grants to institutions Thus the Grocers' Company has three scholarships of £300 a year each, for inquiry into causation of prevalent disease or as to means of prevention of premature death, the Salters' Company has founded its Institute of Industrial Chemistry, which offers fellowships of £250 to £300 a year to chemists of graduate standing to enable them to undergo a special further training for careers in chemical industry, the Drapers' Company has devoted £20 000 to scholarships for the textile industries, and similar endowments have been made by the Leathersellers' Company and the Fishmongers' Company About six years ago the Armourers and Brasiers' Company founded its research fellowship in metallurgy, which is awarded by a committee consisting of three persons appointed by the Company and four appointed by the Royal Society and is of the value of £500 a year Miss C F Elam has done very successful research in metallurgy while holding this fellowship for the past five years, and she still has another six months in which to continue her work Announcement is now made that a new fellow will shortly be appointed Full particulars of the fellowship can be obtained on application to the Secretaries of the Royal Society, Burlington House, London, W 1

WIDESPREAD interest has been aroused by the announcement made by Mr Leonard C Woolley in the *Times* of Mar 16 that he has discovered at Ur evidence for the historicity of the Flood of Genesis and Mesopotamian legend In excavating the deposits belonging to the early occupation, to which reference has been made in previous communications, he found relics of human activity on the low lying parts of the island which had been submerged under a huge bank of water laid clay of some eight feet in thickness On top of this was a fresh occupation which carried on some of the old traditions but departed entirely from others There is thus a break in continuity caused by this disaster which he suggests can be none other than the flood of Sumerian history and legend

COMMENTS by Sir E A Wallis Budge and others appear in the *Times* of Mar 18, and they generally

accept Mr Woolley s suggestion The most interesting comment is that made by Prof S Langdon of Oxford who has revealed some hitherto unpublished evidence from the expedition at Kish which conclusively points to the historical nature of the Bible story At Kish where excavations have been carried down to virgin soil, are two precipitations of clay containing potsherds and stranded fish lying perfectly horizontal in a way which could only be the result of a flood This flood took place between 3400 B C and 3200 B C Another deposit of a similar character on the water level is dated at about 4000 B C Prof Langdon is inclined to regard the flood of Genesis as the one between 3400 B C and 3200 B C, which he connects with the Sumerian legend of Ziudzudra, the last of the antediluvian kings in the traditional royal lists who built a boat to escape the waters This legend was incorporated in Babylonian story and thence reached the Hebrews In view of the extreme interest of this theory, it is scarcely necessary to stress the importance of securing continuity of excavation at both Ur and Kish We hope that public interest may be stimulated by this latest discovery to provide the necessary funds

It is now more than six years since the inauguration of broadcasting produced a world wide demand for a loud speaker A paper by R P G Denman on the development of these instruments was read to the Royal Society of Arts on Mar 13 The early forms of loud speakers were incapable of radiating sound the frequency of which was below about middle C (256) This was not at first recognised as the ear has a marvellous power of reconstructing a mutilated complex tone A pure tone is essentially a single vibration which follows the sine law In a complex tone we have one or more overtones in addition The B B C recently carried out experiments to determine the minimum value of the amplitude of the second harmonic which must be superposed on the first harmonic so that it becomes noticeable in an ordinary loud speaker

It was found in the B B C experiments that when the frequency of the fundamental was 900 the amplitude of the second harmonic has to be at least 3 per cent of the amplitude of the fundamental before it becomes audible At higher frequencies a much greater percentage is necessary When the frequency, for example is 5000 the percentage of the amplitude of the second harmonic required for audibility is 49 The introduction of cone loud speakers and the annulment of resonance effects by frequency filters were notable steps in advance The efficiency of transformation of all ordinary loud speakers is very low Some of the loud speakers however used in the commercial operation of Movietone and Vitaphone talking film systems have efficiencies of 30 per cent A new Western Electric loud speaker is claimed to have a fifty per cent efficiency It seems probable that great improvements will be made in the near future in the instruments used in theatres and that the small domestic loud speaker will either remain as it is or become similar to a small auditorium instrument

At a meeting of the Section of Neurology of the Royal Society of Medicine, held on Mar 14, a kinematograph demonstration was given of a film, showing some of the experiments on conditioned reflexes done in Prof Pavlov s laboratory at Leningrad Although the work and conclusions were familiar to most of the audience, yet it was obvious that the film proved interesting giving, as it did, a reality to experiments hitherto known only through verbal descriptions in text books The film is not intended for the general public, but as a means of illustrating lectures for students as such it certainly seems to have many advantages There is, however, a possibility of danger, for it would be very easy to select a series of experiments because they happen to illustrate a thesis and to omit the negative instances the arresting nature of the presentations renders this more serious than in any other form of exposition There can be no question as to the scientific value of Prof Pavlov s experiments but the deduction therefrom that man is nothing but a bundle of conditioned reflexes is fallacious The Society is to be congratulated on the novel and provocative form of meeting

The controversy about the future development of the Bodleian Library has been closed by the acceptance of a decree in Congregation authorising the University Chest to receive subscriptions for the carrying out of a definite scheme of extension The scheme is of the nature of a compromise and is probably not thoroughly satisfactory to any of the interested parties It involves the transformation of part of the north side of Broad Street one of the characteristic features of Oxford and also the removal of some of the Bodleian stores to a site three miles distant from the city A recent decision of the Curators to exclude certain kinds of literature considered to be of merely ephemeral value gives rise to some difference of opinion, many people holding that publications of this kind may become with the lapse of years, of great interest and importance as illustrating manners and modes of life of the present day

The Zoological Society of London celebrates this year the centenary of the granting of its Royal Charter in 1829 three years after the formation of the Society itself and an announcement has just been made of the manner in which the occasion is to be commemorated The large number of fellows of whom there are now more than 8000 has made necessary the arranging of more than one function A centenary celebration meeting will be held in the Great Hall University College Gower Street, on April 29 when centenary speeches will be delivered and official and foreign guests will be present In the evening of the same day the foreign and official guests will be entertained to dinner by past and present members of council and other officials of the Society The greatest gathering of all will be a centenary celebration garden party, to be held at the Society s Gardens on the evening of June 20, and to this every fellow will receive an invitation for himself or herself and one guest In an earlier note we referred to the historical account of the development of the Society to be written by Dr P

Chalmers Mitchell, and we understand that this interesting volume is well advanced

As recently announced by the Prime Minister of the Commonwealth of Australia, the Commonwealth Government is promoting an expedition, under the leadership of Sir Douglas Mawson, for scientific and survey work in the Antarctic lands lying south of Australia The British Government is making a financial contribution sufficient to enable the R R S *Discovery* to be placed at the disposal of the Expedition It is anticipated that the investigations will occupy two seasons, from the summer of 1929 to the summer of 1931 Every effort will be made to maintain the closest co operation between the Australian work and that already in progress under the *Discovery* Committee, and in order to assist in securing complete uniformity of method a member of the *Discovery* staff will be seconded for service with the Australian Expedition In view of the loan of the *Discovery* to the Australian Expedition, the Secretary of State for the Colonies has sanctioned the construction of a ship which, with the *William Scoresby*, will enable the work of the *Discovery* Committee to be continued The new vessel will be a steamship with a superior radius of action, and will be able to undertake long ocean traverses for which the *Discovery* is not well suited She will carry echo sounding gear and also a specially designed winch, carrying 5000 fathoms of wire rope, for working large nets at any depth For smaller nets and hydrological observations three auxiliary machines will be provided Large biological and chemical laboratories on the upper deck, a photographic room and a survey office, workshop store rooms and other accommodation necessary for the intended service are being provided In addition to a full complement of executive officers, she will carry a scientific staff of six and a survey officer, the total of officers and crew being about fifty The vessel is being constructed at Port Glasgow by Messrs Ferguson Bros (Port Glasgow), Ltd

ON Tuesday, Mar 12, Dr H Przibram, professor of experimental zoology in the University of Vienna, delivered, at the request of Prof E W MacBride, a lecture on the "Transmission of Acquired Modifications from Parent to Offspring" in the Imperial College of Science Dr Przibram commenced by referring to the four postulates in Weismann's theory of natural selection, and stated that every one of the four has proved to be untrue He also referred to theories of Mendelian inheritance, depending upon 'genes,' which would require modification in the event of the discovery that acquired modification could be transmitted to offspring Dr Przibram pointed out that although no one sufficiently skilled to be able to repeat the work of his pupil, Kammerer, on rearing Amphibia for several generations had yet appeared, Kammerer's results, so far as the effects of the environment on one generation are concerned, had received abundant confirmation in recent years, the latest of these being the discovery in the Jardin des Plantes in Paris of a strain of *Alytes* which bred in or near the water, in which the males had vestigial 'nuptial pads' on their hands

DR PRZIBRAM described a long list of experiments made in recent years which had given evidence of the transmission of acquired characters Many of these have been performed in his own laboratories under his supervision, and incidentally he remarked that the fact that some people had tried to repeat them and failed was no disproof of their validity, for in experiments of this kind where conditions are complicated, the failure to get one condition out of the whole number right was sufficient to upset the experiment Perhaps the most interesting part of the lecture was that in which Dr Przibram outlined his attempt to analyse how environmental effects are transmitted to offspring, thus rats brought up in high temperatures have longer tails than those bred at low temperatures, but the heat of the air does not act directly on the growth of the tail, but indirectly, by stimulating metabolism and increasing body temperature One is involuntarily reminded of that far seeing dictum of Lamarck's "But what ever it does, the environment never directly affects the growth of an animal, but indirectly by altering its needs necessitating fresh efforts on the part of the animal to satisfy them, causes it to use some parts more than others and so stimulates their growth"

IN the course of an address on "Road Transport," read before the Junior Institution of Engineers on Mar 8, Mr S H Hole stated that the first practical mechanically propelled road vehicle was the steam tractor built by Cugnot in 1769, which carried four persons and attained a speed of $2\frac{1}{2}$ miles per hour, an improved type was designed to carry $4\frac{1}{2}$ tons at the speed mentioned, and cost £800 In 1798, Trevithick and Vivian patented inventions relating to high pressure steam in connexion with locomotion, and in 1803 had a road vehicle in operation in the streets of London Between 1827 and 1830, steam coaches were in operation between Gloucester and Cheltenham which had an average speed of 12 miles per hour with a maximum of 20, and they were operated successfully in London until Parliament enforced tolls in the proportion of 12 to 1 as compared with the four horse coach, and they thus fell into disuse A still further check to the progress of mechanical transport was the Act passed in 1865, limiting the speed of mechanically propelled vehicles in the country to 4 miles and in towns to 2 miles per hour, with a flagman in front The years 1906 and 1907 saw important changes in motor car design, when magnetos replaced coil and battery ignition and the worm drive to the live back axle, coupled with a differential gear, was built by Lanchester The more rapid development in mechanical transport, both for goods and transport, during the past twenty years, has been due largely to research on the properties of special steels, this has enabled great reductions in weight to be made without sacrifice of reliability The progress in machine tools and in the scientific balancing of engines, especially for aeroplane purposes, have all aided the evolution of the modern car Further lines of progress will be in the number and positioning of cylinders, higher speeds of engines combined with decreased weight and greater flexibility

The dramatic element in aerial flight has always appealed to the popular press and would have succeeded in maintaining a live interest in that subject whether the technical men were active in it or not, but the scientific interest has been steadily pursued, and the time is rapidly approaching when special journals will require to be produced to cater particularly for this development Germany has already a number of journals of this type In Great Britain we have been very prone in the past to maintain our scientific journals in omnibus type, and only workers in such specialised fields realise the difficulties involved in digging out and collecting the papers they are concerned with from these various miscellaneous journals, our scientific press is certainly not scientifically organised On the aeronautical side, the reports of the Aeronautical Research Committee have in this respect pursued a very effective policy, but they suffer from two disadvantages They are in the first place almost entirely confined in their publications to the work which is being undertaken in Government research establishments in the second place, they are issued to the public almost a year after the work has been executed Scientific workers, therefore, not professionally in immediate contact with these places, but striving to work in these fields, must continually lag behind in respect to any developments that have occurred No doubt there are difficulties in the way of earlier issue to the public A new journal, styled *Aircraft Engineering*, under the able editorship of Lieut Col W Lockwood Marsh, has now made its appearance—an old title for a new paper In format it is not unlike *Engineering* itself, but it is a monthly journal and restricts its attention to those matters of direct interest in the design and construction of aircraft and in research work on aerodynamics It is intended to be a scientific and technical journal for aeronautical engineers and research workers The first issue in March contains, among other important articles, a résumé of the research and technical progress in 1928, special discussions on stream lining of air cooled engines, on a new theory of tail flutter, and on the efficiency of the auto gyro If the standard of succeeding issues can be maintained, this journal should play a very important part in the concentration of aeronautical publication

According to the annual report of the U S Bureau of Standards for the year ending June 1928 (Washington, D C Government Printing Office, 5 cents) the work of the Bureau has been divided into two groups, the first dealing with scientific research and testing, the maintenance of standards and their improvement, the second with the supervision of commercial standards with special reference to the needs of industry The regular staff now numbers 860, and the salaries 572 thousand dollars per annum The fee values of the tests carried out by the Bureau were for the public, 67 thousand dollars, for the Government and States, 351 thousand dollars, and for the Bureau, exclusive of research and standardisation tests, 46 thousand dollars Upkeep of the buildings, plant and grounds has cost 83 thousand dollars and additions 88 thousand dollars. The work done is summarised under various headings, the total cost of each group is stated, and ten or a dozen lines are devoted to a description of each research of the group

In order to test structural and miscellaneous materials, the Bureau of Standards maintains three branch laboratories, one at Northampton, Pa, one at Denver, Col and one at San Francisco These branch laboratories are fully occupied, and there is need for increase of personnel and equipment to cope with the ever growing increase in the work In view of the hazardous tests sometimes carried out at the Bureau a demand is made for a first aid station under the care of a competent physician Elaborate apparatus has been constructed in order to obtain a more accurate value of the constant of gravitation, as a knowledge of this constant is necessary in many tests The tests made with metal furniture prove that the fire risk is considerably diminished by its use Metal shelving in particular prevents a fire from spreading The large variation in the index of refraction of lead glass with the annealing temperature has been investigated Good practical work has been done in developing radiobeacons for aeroplanes A demonstration between two air ports was given of a new type of beacon which produces visual signals on an instrument on the aeroplane board Aeroplanes fitted with these instruments can fly perfectly safely in fog or darkness between these ports although no landmarks are visible

The Council of the Royal Society of Edinburgh has awarded the Gunning Victoria Jubilee Prize for the period 1924–28 to Prof Edmund Taylor Whittaker, in recognition of his distinguished contributions to mathematical science, and of his promotion of mathematical research in Scotland and the Makdougall Brisbane Prize for the period 1924–28 to Dr W Ogilvy Kermack, for his contributions to chemistry, published in the Society's *Proceedings* and elsewhere

The Council of the Iron and Steel Institute has this year decided to present its Carnegie Gold Medal to Dr Arthur Bramley, head of the Metallurgical Department of the Loughborough College The Medal which was founded by the late Mr Andrew Carnegie, is awarded to the research worker who, in the opinion of the Council, has produced the most meritorious piece of research work in each year under the scheme of the Andrew Carnegie Research Scholarships of the Institute

At the invitation of the Société Française des Électriciens, the summer meeting of the Institution of Electrical Engineers will be held in France on June 11–22 The Paris Orléans and Midi Railways are providing railway transport free of charge for a trip to the Pyrenees, and the Chemin de Fer du Nord will transport the party between Calais (or Boulogne) and Paris at half fare Numerous visits to works and places of interest are being arranged

A public meeting on Developments of British Chemical Manufactures has been arranged by the British Science Guild and will be held in the Mansion House, E C 2, on Wednesday, April 24, at 4 30 P M, when the Rt Hon Lord Melchett, president of the

Guild, will take the chair The programme will include the following addresses (1) "Fertilisers from the Air," by Sir Frederick Keeble, (2) "Rayon (Artificial Silk)," by A B Shearer, and (3) 'Synthetic Drugs,' by F H Carr Tickets for the meeting may be obtained on application to the British Science Guild 6 John Street Adelphi, W C 2

A SEVERE earthquake occurred in the North Atlantic on Feb 22 at 3 41 P M The position of the epicentre is given by the seismologists of the U S Coast and Geodetic Survey as approximately in lat 10° N, long 42° W, or about a thousand miles from the mouth of the river Amazon (*Daily Science News Bulletin*, Science Service, Washington, D C) This region is one of the belts of seismic activity in the Atlantic Ocean and was the scene of a severe earthquake in October 1925, recorded by instruments all over the world As it also lies along the course of vessels between New York and Pernambuco, the shock must have been felt on any passing ships as if the vessels were grating on the ground below

A NEW part (No 813) of Sotheran s invaluable "Catalogue of Science and Technology ' has reached us Its designation is Part IX XIII Engineering, Section 1 and gives the titles of and much bibliographic information respecting periodical publications, early works to the end of the eighteenth century and general works including lives of engineers The list can be had upon application to the publishers, 140 Strand W C 2

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —Temporary assistants and temporary sub assistants in the Herbarium of the Royal Botanic Gardens Kew—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S W 1 (April 8) A sub inspector of quarries in the Midland and Southern Division of the Mines Inspectorate—The Under Secretary for Mines Establishment Branch, Mines Department Dean Stanley Street Millbank, S W 1 (April 20) A secretary of the Institute of Physics and editor of the *Journal of Scientific Instruments*—The President Institute of Physics, 1 Lowther Gardens, S W 7 (April 21) A director of extra mural studies in the University of Birmingham—The Registrar, The University, Birmingham (April 27) A clinical pathologist at the Crichton Royal Mental Hospital—The Physician Superintendent Crichton Royal Mental Hospital Dumfries A clinical bacteriologist at the Cheshire Joint Sanatorium Market Drayton The Medical Superintendent Cheshire Joint Sanatorium Market Drayton A male junior assistant under the Directorate of Ballistics Research Research Department, Woolwich—The Chief Superintendent Research Department, Woolwich

Our Astronomical Column

A PROBABLE NEW TROJAN PLANET —The Trojans are a group of minor planets the period of revolution of which is the same as that of Jupiter, and which maintain an approximately constant position relatively to Jupiter, four of them, Achilles Hector, Nestor Agamemnon are 60° in front of Jupiter while Patroclus and Priamus are 60° behind it *Beobachtungs Zirkular* No 7 states that Nestor was photographed by Dr Reinmuth at Konigstuhl on Feb 9, on the same plate, 46 east of Nestor and 36 north of it, another planet was found with the same motion as Nestor in Right Ascension (− 0 5 m daily) This is much slower than the average retrogradation of the asteroids when near opposition, and makes it probable that the new body belongs to the Trojan group Its provisional designation is 1929 CM It is slightly brighter than Nestor, their magnitudes being 14 2 and 14 8 respectively 31 new planets were discovered in the first half of February

THE SPECTRA OF COMETS —The theory of Schwarzschild and Kron on the nature of comets tails is extended by H Zanstra in the *Monthly Notices* of the Royal Astronomical Society, vol 89, p 178, to explain the line and band spectra of the heads. It is suggested that the observed lines are resonance lines producible under low excitation, or in some special instances are caused by fluorescence, in other words, sunlight is absorbed by the gases of the comet's head and then re emitted in the same (or sometimes longer) wave length The intensity of the spectrum to be expected from this theory is computed and compared so far as possible with actual observations The result seems to show that the theory is quite sufficient to account for the observed luminosity in the case of such comets as are considered, though some of the very bright comets with only one known apparition may provide a severer test One example of such comets (Comet Wells 1882) is discussed in some detail The *D* lines of sodium were observed to be very nebulous which is in agreement with the requirements of the theory while the iron lines noticed in this comet are capable of explanation by fluorescence

THE UNIVERSITY OBSERVATORY OXFORD —The report of this Observatory for 1928 has been issued It records the completion of the measurement of the plates taken at the Vatican Observatory for the Astrographic Catalogue and sent to Oxford for measurement the Pope has presented medals to the director and his assistants in recognition of their share in this work The zeal of the director Prof H H Turner for the completion of the whole Catalogue is well known He has undertaken to complete the southern portion (+ 32° and + 33°) of the zone originally allotted to Potsdam The northern portion is being undertaken at Hyderabad, and it is hoped that the middle may be filled in by an observatory in the United States

Allusion is made in the report to Dr Fotheringham s work on the Venus tablets of Ammizaduga, in conjunction with Prof Langdon, and to his studies on the relation between Babylonian and Greek astronomy, with special reference to Naburianos and Cidenas

The new buildings in the Observatory have been completed The seismographs have been moved there from the Clarendon Laboratory The upper rooms afford a much needed extension to the Library Five papers and reports on seismology by the Director have been published since the last annual report The coelostat belonging to the Observatory has been lent for the expedition to Siam to observe the total solar eclipse of May 9

Research Items

NEOLITHIC FAYUM POTTERY.—In *Ancient Egypt*, 1928, pt. 3, Miss G. Caton Thompson has released in advance an account of the neolithic pottery of the Fayum pending adequate publication of the material collected in the three seasons' investigations, of 1924–1925, 1925–26, and 1927–28. The bulk of the material is from a larger midden settlement, Kom W, of more than 600 ft. by 400 ft. and about 5 ft. deep. It belongs almost entirely to the earlier Neolithic or Fayum A period. Other and better preserved vessels came from straw lined granaries. Some were found singly in other parts of the desert. All the pottery is handmade in coarse clay with straw as a *dégraissant*. Unequal and insufficient firing has produced a grey mottling on red pots, the core in nearly all cases being black and soft. Owing to the combination of organic matter from the midden and the salt of the desert, the texture has suffered and few pots retain their original surface. Many of the pots were rough faced and devoid of slip and burnish. Some may originally have had a slip. A polished ferruginous wash and a burnished black finish were frequently used. One class (class 5) is associated with a thin ferruginous slip, polished and of a purple red colour similar to the old Nile Valley pre-dynastic wares. Black polish is rare. A few sherds were hand smoothed. The forms are grouped into five classes: (1) Small bowls and cups; (2) cooking bowls or pots—these two classes being of the type common to all primitive ceramic development; (3) pedestal cups, an important class suggesting the prototype of rare and early Nile Valley pre-dynastic vases—this form occurs in the Middle Neolithic stratum at Knossos; (4) cups, with legged bases—poorly represented; (5) rectangular dishes with 'peaked' rims—a type which appears to have no parallel in the pre-dynastic period.

MILK YIELD OF DAIRY COWS.—A statistical analysis of the data of the Scottish Milk Records Association by Dr. J. F. Tocher has been issued by the Biometric Laboratory, University College, London (*Biometrika*, vol. 20, B, pt. 2, p. 105; 1928). There is a distinct improvement in the milk yields of recent years compared with those of twenty years ago, from an average of 16½ gallons to one of 18½ gallons per week. The yield per week is shown to vary with age of cow. Young cows give an average of less than 16 gallons, whereas cows of 9–11 years give more than 20 gallons. There has also been an average increase in total butter fat, amounting to 7 per cent. The monograph is profusely illustrated with diagrams and photographs, and contains a number of tables, some of which should be of value to the practical dairy farmer. For example, there are tables showing the yield of milk for each stage of lactation period, and one showing the average amount of butter fat obtained for cows of a given age and for a given length of lactation period. A farmer could thus compare the actual yield of a cow with the average, and so determine whether she is up to standard.

CONTROL OF POWDER POST BEETLES.—Beetles of the genus *Lyctus* are commonly termed 'powder post beetles' from the fact that their larvæ bore into timber and, as a result, give rise to the production of a fine powdery dust or 'frass'. Particular attention has been paid to these insects at the Forest Products Laboratory at Princes Risborough, and the result of recent inquiries are embodied in *Bulletin* No. 2 (1928), Forest Products Research, by Dr. R. C. Fisher. Evidence has been collected which indicates that the increase and spread of these insects in Great Britain since the War have been due to the importation of infested American ash and oak. Among the most notable facts stressed in this *Bulletin* is the egg laying habits of these beetles. In the species studied the eggs are always inserted within the vessels or pores of the wood, whether they be transversely or horizontally exposed, and are never laid on the surface. It is therefore impossible to see a *Lyctus* egg except by microscopical examination of the wood. A definite correlation has been found between *Lyctus* attack and the size of the vessels in different kinds of wood. So far as is known, the insects never attack conifers, probably owing to the absence of vessels or pores in which their eggs could be placed. Not all hard woods are attacked, and those with large vessels are the most liable to suffer; such close grained timbers as beech and birch have not been observed to be attacked, and it is very probable that the size of their vessels is too small to allow of the insertion of a *Lyctus* egg. In so far as control measures are concerned, the Laboratory has concentrated its attention upon the practicability of heat sterilisation of infested timbers before practical utilisation. Humidity is an important factor to be taken into account, and there is evidence that prolonged treatment with humidity between 60 per cent and 70 per cent, provided the temperature does not fall below 120° F., would probably suffice for the purpose. The *Bulletin* may be obtained, price 3*s*. net, from H.M. Stationery Office or through any bookseller.

THORACIC APPENDAGES OF *ANOPHELES* LARVÆ.—The existence of peculiar paired dorso lateral organs on the anterior region of the thorax of *Anopheles* larvæ was described by Nuttall and Shipley in 1901, and confirmed by Imms six years later. On account of their transparency these structures are not easily seen, and this probably explains why they have been almost entirely overlooked by subsequent investigators. Mr. M. O. T. Iyengar, in the *Indian Journal of Medical Research*, vol. 16, No. 2, 1928, has studied these organs in 29 species of *Anopheles* besides examining many Culicine larvæ, but in the latter creatures the thoracic appendages were entirely wanting. Each appendage is capable of contraction and extension, and is moved by a special muscle. Morphologically the organ consists of a basal pedicle and two apical lobes, each of which is provided with a flat cuticular expansion. It is believed that the thoracic appendages, by maintaining close contact with the surface film, act as anchoring organs which maintain the larva in a constant position, and enable it to withstand the forward 'creep' while working its mouth brushes and thus setting up a current in the water. In the case of a Culicine larva, the movements of the mouth-brushes causes the animal to move in a forward direction all the time it is feeding.

NEW BIVALVES FROM SOUTH AMERICA.—In a paper entitled "New Freshwater and Marine Bivalve Shells from Brazil and Uruguay" (No. 2762, *Proceedings of the United States National Museum*, vol. 74, art. 17), Mr. William B. Marshall, assistant curator, Division of Mollusks, United States National Museum, describes a new pearly freshwater mussel from Brazil, four new freshwater mussels and three marine bivalves from Uruguay. *Diplodon Jacksoni* n. sp. is a handsome shell collected by Mr. Ralph W. Jackson of Cambridge, Md., from Arcas, Province of Mines, Geraes, Brazil. Its beak sculpture is usually well preserved and the whole shell measures 49 mm. by 28 mm. (type specimen). It is closely related to *Diplodon santamariæ*. The mussels from Uruguay are a Diplodon, two Anodontites and a Mycetopoda.

A Corbula and two Nuculas from Uruguay are also described One of the Nuculas, *Nucula Felipponei*, called after the donor, was taken from the stomach of a fish known as a corbina, *Micropogon undulatus* Photographic plates are given of all these new species

THE CULT OF THE PRIMULA —The first hundred pages of the *Journal of the Royal Horticultural Society*, vol 54, part I, 1929, are taken up with the report of the proceedings of the fourth Primula Conference, held under the auspices of the Society on Thursday, May 24, 1928, during the Chelsea Show The greater part of the space is occupied by the important paper by Prof W Wright Smith of Edinburgh and Mr G Forrest upon "The Sections of the Genus *Primula*" This paper has previously been published in the *Notes from the Royal Botanic Garden*, Edinburgh, No 76, March 1928 Accompanying this paper in its present, somewhat altered, form are a large number of beautiful photographic illustrations of various species of *Primula* Similar photographs accompany many of the other papers, which include some interesting notes on the Primulas of the Far East, especially a valuable discussion of their natural habitats in the East, by Dr W Handel Mazzetti, of the Natural History Museum, Vienna There are also valuable notes on cultural experience with difficult and rare species, whilst the workers at the John Innes Horticultural Institute are responsible for some interesting communications upon genetic experiments with *Primula* The late Dr Bateson commenced experiments upon the genetics of *P sinensis* so far back as 1903, these were continued by Mr Gregory and had yielded many valuable results before they were cut short by his untimely death in 1918 The three papers in the *Journal* upon *P sinensis*, *P Kewensis*, and *P Juliae* and its hybrids with the oxlip and primrose, are brief and clear summaries of the present state of our knowledge of the genetics of these species

JOLY'S THEORY OF THERMAL CYCLES —In a recent number of *Gerlands Beiträge z Geophysik* (vol 20, p 288, 1928), Prof J Joly replies to criticism by Dr F Lotze He points out that the theory of thermal cycles is more in keeping with the complexity of the earth's surface history than one of uniform loss of heat The suggestion of Dr J W Evans that radioactive energy may be in large part expended on chemical changes within the rocks dies hard Joly again directs attention to the fact that this suggestion is in flat contradiction with all investigations bearing on the subject He further claims, in opposition to Lotze, that volcanic heat liberated at the surface is negligible in quantity, and that it cannot be supposed to proceed in its entirety from the deep lying substratum which is responsible for the cycles. Perhaps the most interesting feature of this short paper is the tacit abandonment by Joly of the 'short' estimates of geological time, of which in recent years he has been by far the most ardent advocate On p 289 he asks, "To what other source than the theory of thermal cycles can we refer the repetitional character of earth history covering much more than a thousand million years?" Later, he states that "the surface history of the earth must have already run some thousand millions of years when the Appalachian Revolution took place" The momentum of the older view favouring a hundred-million year earth may now be said to have spent itself, leaving a clear field for the development of a geological time scale based on radioactive disintegration

DOMESTIC GRATES AND COKE —In a lecture delivered on Jan. 16 and printed in the *Journal of the Royal Society of Arts* for Feb 15, Prof C R Darling put before the Society what he considers a practical solution of the domestic smoke problem He has used, for two years, a grate for burning gas coke, in which the difficulty of ignition has been met by the incorporation of a gas burner This grate, introduced by the South Metropolitan Gas Company, seems satisfactory and economical, so that, taken in conjunction with other appliances and smokeless fuels available, Prof Darling considers that there is no technical obstacle to a large immediate reduction of domestic smoke This would follow the replacement of raw coal by gas coke and anthracite where possible, and so far as available Meanwhile the development of low temperature carbonisation processes will result in additional supplies of smokeless fuels to supplement the coke by the time demand for coke overtakes supply Technically, Prof Darling's claims are well founded The room heating efficiency of gas coke consumed in an open grate is greater than that of coal and at least as great as that of low temperature cokes The grate, however, must be accommodating to the peculiarities of coke, but the monetary saving following the use of coke will easily pay the cost of adaptation Unfortunately, in the matter of home heating, custom, prejudice, and æsthetic considerations often determine the choice, not technical efficiency Moreover until the ash content is brought much nearer to what is customary in house coal, it will be hard to secure the general adoption of coke in the open domestic fire

EFFECT OF ANTI KNOCK MATERIALS ON FLAME SPEED —The *Proceedings of the Imperial Academy of Science*, Tokyo, vol 4, No 9, contains a paper by Y Nagai on the speed of the initial uniform movement of the flame in hydrocarbon–air mixtures The effect of the addition of up to 25 per cent of diethyl selenide, tetramethyl tin, and tetramethyl lead to such mixtures was investigated in a long glass tube The flame speed, which was measured photographically, decreased with the concentration of the anti knock agent up to a certain point This effect is explained by a consideration of the differences between the theoretical propagation temperatures of the hydrocarbon (1450°) and diethyl selenide (1750°) and the tetramethyl compounds (both 1680°) It is suggested that the theoretical flame propagation temperature of the hydrocarbon is raised by addition of the anti knock compound until it reaches the corresponding temperature for that compound The maximum anti-knock effect is then obtained

AMATEUR KINEMATOGRAPHY —Dr C E K Mees has contributed an article to the January issue of the *Journal of the Franklin Institute* which includes an account of the Eastman Kodak Company's new Kodacolor process, which has been specially designed for the production of coloured films by amateurs In this, a colour filter with three separate areas—red, green, and blue—is used over the surface of the camera lens, and the film surface, instead of being flat, is embossed with small cylindrical lenses of the film material by forming it through steel rollers These lenses intercept the light directed on to the sensitive emulsion, which is at the back of the film, and so impress upon the latter three distinct sets of images, one for each of the primary colours of the filter The film is developed by a reversal process, and projected through an optical system which is essentially the same as that used for its production, the triple filter appropriate to the colour sensitivity of the emulsion being again placed over the lens A drawback of this method appears to be that there is considerable absorption of light by the colour filter used in projection,

with the result that only small pictures can be thrown on to the screen, but Dr. Mees states that although the Kodacolor process has been on the market for only a short time, the results that are being obtained show quite definitely that it is successful, and that with reasonable care there is no more difficulty now in obtaining motion pictures in colour than in the making of still photographs.

COSMIC RAYS.—The papers on cosmic rays that have appeared in Continental journals during the last three years have not hitherto led to any new results which have been generally accepted, and have not attracted much attention. Most of them have, however, included detailed reports of the observations which have been made, and have thus furnished a valuable collection of data for a statistical investigation, which has now been performed by A. Corlin, of Lund Astronomical Observatory, and published in the form of a *Communication* (No. 115) from this observatory in the *Zeitschrift für Physik* (vol. 50, p. 808). His analysis has brought to light a consistent variation in the intensity of the softer components of the radiation during the sidereal day. A maximum occurs at about 15h., a minimum at about 11 h., and a second, but less definite maximum, at about 7 h. The finer details of the intensity time curves of different investigators also show a certain degree of similarity. If soft rays are screened off from the ionisation chamber, temporal fluctuations are not present. The obvious inference is that the more penetrating cosmic rays are produced indifferently throughout space, but that at least a part of the softer radiation has a more localised origin. In a second *Communication* (No. 116) which has been published in the *Arkiv for Matematik Astronomi och Fysik* (vol. 21, No. 1) it is suggested that the softer rays are really initially hard, but that they are produced inside material celestial bodies and are softened by scattering on the way out. Further investigations are evidently needed to settle the important points that have been raised in these two papers and, as is pointed out, it would be extremely valuable if it could be arranged that simultaneous records of the ionisation produced by the cosmic rays were made at different latitudes.

THE PREVENTION OF IONISATION IN PAPER DIELECTRICS.—Messrs. S. G. Brown and P. A. Sporing read a paper on the prevention of ionisation in paper dielectrics to the Institution of Electrical Engineers on Mar. 14. It is known that the performance of paper dielectric condensers, which are much used in Great Britain in connexion with 600 volt alternating current systems, has not been satisfactory. After a period of service of about a year an appreciable number of breakdowns occur, and this takes place even when the condensers are subjected to very severe tests before installation. Very similar results have also been observed in connexion with cables insulated by impregnated paper. There is now a very large amount of evidence which supports the view that the breakdown is due to the presence of air bubbles in the dielectric. It is found that when the voltage applied to the cable or condenser is increased, then at a certain voltage, called the critical or ionisation voltage, the power taken by the cable suddenly begins to increase rapidly. The assumption is usually made that if the dielectric be worked below the critical voltages then ionisation of the enclosed air cannot take place. The authors show both by experiment and theory that this is not the case. They explain some of the phenomena observed by recalling the experimental results obtained by Lord Rayleigh and others on the electrical properties of thin layers of air. It is known that however close together two electrodes are in air at atmospheric pressure, then ionisation does not ensue unless the voltage exceeds a number which is approximately 330. They utilise this theorem in the design of condensers. Instead of increasing the thickness of the dielectric, they build it up of a large number of thin sections in series in such a way that the voltage across any one section does not exceed that required for ionisation. The same effect can be produced by placing isolated conducting layers (interleaves) in the dielectric. Great advantages are stated to accrue from this method of construction.

HYDRAZINE HYDRATE SOLUTIONS.—The concentration of hydrazine hydrate solutions, which usually contain less than 30 per cent. of available hydrazine, has hitherto been a matter of considerable difficulty, but a simple method of concentration is described by Hurd and Bennett in the *Journal of the American Chemical Society* for January. The hydrazine hydrate is mixed with a quantity of xylene and heated until the xylene has distilled away. The amount of xylene used determines the concentration of the residual hydrazine hydrate solution, and solutions containing up to 95 per cent. hydrazine hydrate can be prepared in good yield at one distillation. The aqueous portion of the distillate contains a small quantity of hydrazine which may be recovered. Toluene may be used in place of xylene, but is less efficient; benzene is quite unsatisfactory. Attempts were made to prepare hydrazine by treating its salts with sodamide, calcium carbide and aluminium carbide. With the two latter substances the desired reaction did not proceed, while sodamide reacted explosively unless diluted. The use of hydrocarbons as reaction media caused the reaction to proceed less violently, but only negligible yields of anhydrous hydrazine were obtained.

ARTIFICIAL ANALOGUE OF RUBBER.—The investigation of the problem of the chemistry of rubber by Staudinger and his school has been complicated in the past, on the natural side by the very great susceptibility of caoutchouc to oxidation, and on the synthetic side by the fact that the synthetic caoutchouc produced by condensation of the hydrocarbon isoprene may have a very different structure from the natural material owing to the possibility of molecules uniting together into complex three-dimensional systems. A new approach to the subject is described by Prof. Staudinger in the January *Berichte* (vol. 62, pp. 241-263). Instead of isoprene, the aromatic compound styrene is condensed. This, being a benzene derivative, cannot furnish a true caoutchouc, but the condensed product which it gives, *polystyrene*, may be regarded as a 'model' of the natural substance and can be accurately investigated, since its constituent groups can link together only in one single chain. An interesting discovery is that if the condensation is carried out at high temperatures, for example, 240° C., the product is relatively simple, being composed of some thirty units, whereas if the styrene is condensed slowly at ordinary temperatures it yields a very complex, colloidal substance, composed of some hundred thousand units, and resembling natural caoutchouc. All intermediate degrees of complexity are obtainable by varying the temperature and the time of condensation, and at any temperature the product obtained is a complex mixture of numerous members of a series, comparable with the series of natural paraffins; the most highly condensed products, and these only, resemble caoutchouc in viscosity, and in elastic and swelling properties. Prof. Staudinger concludes that natural caoutchouc is built up on a similar plan to polystyrene, and that it contains long chains of some thousand molecules of the unit 'polyprene,' $[C_5H_8]_x$.

Gravity Expedition of the U S Navy

By Dr F A VENING MEINESZ

IN the course of 1928 an invitation from the Carnegie Institution of Washington was received and accepted to go to the U S A with the apparatus for maritime gravity survey of the Netherlands Geodetic Commission The U S Navy, having received a communication on this subject from the International Union of Geodesy and Geophysics, wished to organise an expedition for determining gravity in the Gulf of Mexico and the Caribbean Sea The Secretary of the Navy, the Hon Curtis D Wilbur, designated the Naval Observatory for making the arrangements

The expedition took place in the autumn of 1928 It consisted of the U S Submarine *S 21*, on board of which the observations were made, and two surface ships, the U S *Eagles 35* and *58* The expedition was under the command of Lieutenant T L Nash, Captain of the U S *Eagle 35*, while Lieutenant J L Fisher had command of the U S S *S 21*, officers of the submarine were Lieuts F S Hall, F D Hamblin, and A R Sodergren The scientific staff on board the *S 21* consisted of Dr Fred E Wright, of the Geophysical Laboratory of the Carnegie Institution, Mr Elmer B Collins, principal scientist of the Hydrographic Office of the U S Navy, and myself

The expedition started from Washington on Oct 2 and completed the following schedule

Leave			Arrive			Number of Observations
Oct	1	Washington	Oct.	2	Hampton Roads	0
Oct	4	Hampton Roads	Oct	8	Key West	3
Oct	10	Key West	Oct	14	Galveston	7
Oct.	19	Galveston	Oct.	23	West Key via Mississippi Delta	7
Oct	29	Key West	Nov	2	Guantanamo (Cuba) via Bartlett Deep	8
Nov	5	Guantanamo	Nov	9	St Thomas via Nares Deep	9
Nov	15	St Thomas	Nov	19	Guantanamo via Caribbean Sea	6
Nov	21	Guantanamo	Nov	27	Washington	5

In addition observations were made in all the harbours, of which Hampton Roads Guantanamo, San Juan (during trip from Guantanamo to St Thomas), and St Thomas, were gravity stations, which have not been occupied before The total number of new stations amounted therefore to 49

The pendulum apparatus was mounted in the central control room of the ship, this was a favourable spot for making the observations, as it is near the metacentre of the ship, so that the rolling and the pitching cause only small translations of the apparatus The apparatus is hung in gimbals, which makes it possible to work it even if the rolling or pitching is very great, a few observations have been made with a roll of 7° to both sides of the vertical, and with a slight modification of the gimbals it is hoped that in the future observations may be made with still larger angular movements In this way it was often possible to work at periscope depth During the return however, from Guantanamo to Washington the Atlantic was so rough near Cape Hatteras that the two observations which had been planned above the top and above the bottom of the continental slope could not be made, as the ship's movement at 100 feet depth exceeded the limit of 7°

The apparatus used has been constructed at the workshop of the Meteorological Institute at De Bilt (Holland) by the chief mechanic L M van Reet, begun in 1925, it received its final shape in the spring of 1928 by the rearrangement of the photographic recording apparatus It consists of a pendulum apparatus and a recording apparatus, combined in one unit hung in gimbals

The pendulum apparatus contains three half second pendulums swinging in the same plane, in order to avoid magnetic influences brass pendulums are used, although of course their temperature constants are great An insulating cover reduces the changes of temperature inside the apparatus As however, the central control room of the U S S *S 21* showed less variation of temperature than the control rooms of the submarines with which I made previous voyages the temperature inside the apparatus was likewise more stable it seldom showed greater fluctuations than a few hundredths of a degree

The pendulums are not recorded separately but combined in two pairs For each pair the difference of the angles of elongation is recorded and this angle may be considered as the angle of elongation of a fictitious pendulum of the same period as the original pendulums It can be shown— and this is the fundamental principle of this method for determining gravity at sea — that the movement of this fictitious pendulum is free from the principal disturbing effect of the ship s movements the effect of the horizontal accelerations The records of the two pairs which the apparatus provides are therefore nearly regular, there remain only small disturbances by the vertical accelerations of the apparatus and by the tilt of the swinging plane The first is practically eliminated by taking the mean pendulum period over a sufficiently long period of observation for this purpose half an hour is more than enough The second makes it necessary to apply a certain correction to the result which can easily be computed if the tilt is known The apparatus is therefore provided with an auxiliary pendulum which can move in a plane perpendicular to the swinging plane and is damped in order to prevent its proper oscillations The position of this pendulum with regard to the apparatus is recorded This correction amounts only to a few units in the seventh decimal place of the second if the tilt is small for example not more than 10 , the gimbal suspension easily keeps it below this limit

Besides the records which have been mentioned, two others are made one of the temperature inside the apparatus and another of the middle pendulum alone This last record is necessary for computing the reduction of the pendulum periods to infinitely small amplitudes it is irregular because the movement of each pendulum is strongly disturbed, but as it is only used for the computation of a small reduction, this gives no special difficulties for the computations

The records are provided with two series of time marks by means of two shutters, which are actuated by electrical circuits opened and shut by two chronometers Each shutter passes during a fraction of a second before the light source which is used for recording purposes

The rate of these chronometers is found by taking wireless time signals, during the recent voyage the signals of Annapolis were used Reception was effected by means of an auxiliary chronometer, provided by the Naval Observatory at Washington, the rate of which had been strongly deranged, so that every 65 seconds a full second coincidence could be observed with the signals, of which the rhythm is the same as of mean time These coincidences were observed by ear through the well known method of putting the contact of this chronometer in series with the telephone of the wireless The appearances and the disappearances of the signals in the telephone have both been used

The rates of the chronometers have been satisfactory, so that the uncertainty resulting from the fact

that the rate during the observation may deviate from the mean rate deduced from the time signals will probably not amount to more than 2 or 3 millidynes in the result for the gravity

The programme of the expedition was chosen with an eye to the numerous geophysical and geological problems in that part of the earth s crust We may mention the question if isostasy prevails in the Gulf of Mexico in general and near or above the Mississippi delta, further, the problem of the Bartlett Deep south of East Cuba and the Nares Deep north of Porto Rico, the question of isostasy in the Caribbean Sea and in the Atlantic between Cape Hatteras and the West Indies, and lastly, the gravity field above the continental slope for that part of the coast of North America

Thanks to the whole hearted co operation of Captain Fisher, who ordered all the dives necessary for the measurements, this programme was fully accomplished This involved a great deal of diving, often several times a day—once even five times in seventeen hours—which meant an additional strain for every body The helpful assistance of the captain, officers, and crew during the whole voyage in all circumstances may here be thankfully acknowledged

Besides the pendulum observations a great number of soundings were taken The submarine was provided with the sonic depth finder of the U S Navy which has given excellent results, not only during submergence, but also at the surface soundings were possible so that the whole route could be covered Over the ocean deeps the soundings were taken at short intervals so that a detailed profile could be obtained

The results of the gravity observations were provisionally computed during the voyage, and at the same time the isostatic reductions of the stations were made at the bureau of the U S Coast and Geodetic Survey so that the complete provisional results were available a few days after the return of the expedition The final computations are now being made at the Naval Observatory at Washington Pending these a definite interpretation is not advisable but a few remarks concerning the provisional results may be given It is not probable that the final results will change these conclusions [1]

The Gulf of Mexico has shown a curious positive anomaly of about 60 millidynes over nearly its whole extent, only north of Yucatan it is somewhat less but the anomaly is still positive Towards Key West and Galveston this anomaly disappears Returning from Galveston to Key West a special series of observations was made over the Mississippi delta in two profiles perpendicular to the contour lines of the sea bottom, in order to investigate the isostatic equilibrium of the earth s crust in that neighbourhood It might be thought likely that deviations of equilibrium would occur because of the great load of material deposited by the river in the Gulf, but the results have not given any evidence in this direction The slight positive anomaly which has been found seems rather to be in accordance with the general trend of anomalies in the Gulf, so that there is no reason to bring them in connexion with the delta and to assume a lag in the re establishment of equilibrium

A second result of importance has been found over the Nares Deep, north of Porto Rico It is in harmony with the few values observed in that part during my former cruise with the Dutch submarine *K XIII* from Holland via Panama to Java It shows great departures from isostatic equilibrium, which probably may be ascribed to stresses working in the earth's crust in connexion with the formation of the deep Over the deep is a great deficiency of gravity, before reduction, it was more than 300 millidynes, and after isostatic reduction about 190 millidynes North and south of the deep the anomaly after isostatic reduction is small, north of the deep it is slightly positive (± 25 millidynes), and south of it on the north coast of Porto Rico slightly negative (- 10 m d) The gravity in Porto Rico is yet unknown, but the U S Coast and Geodetic Survey is planning an expedition for supplying a series of land values in connexion with the results of the expedition, and a few stations on the island will be occupied so that in a short time the continuation of the gravity field through Porto Rico will be known The importance of this land gravity expedition is obvious, it will complete the data which have been found South of the island, positive anomalies of about 40 m d have been found, as has also been the case throughout the whole part of the Caribbean Sea which has been crossed Summing up these results, we see that apparently the great deficiency of gravity above the deep is not accompanied by considerable positive anomalies in the neighbourhood, unless the values on Porto Rico should reveal any such anomalies

Another result worth mentioning in connexion with the deep is that two stations north of the island of Haiti both situated to the west of the Nares Deep, likewise show great negative anomalies (± 120 m d), and even farther to the west, in two stations north of East Cuba, the anomaly is still negative (± - 40 m d) This seems to indicate that the stresses in the earth s crust which are causing the Nares Deep are not limited to the region of the deep itself, but continue much farther to the west The topography itself does not reveal this

The values of gravity found above the eastern part of the Bartlett Deep, south of East Cuba, show smaller anomalies after isostatic reduction than the Nares Deep the greatest negative anomaly above the deep is 61 m d, while most of the anomalies found to the north or the south of the deep are less than + 25 m d This gives the impression that the stresses in this part of the crust are smaller than those near Porto Rico

Lastly, we will mention the results found in the Atlantic Ocean on the way back from Guantanamo to Washington The three stations above deep water, which are all situated near the bottom of the continental slope show small positive anomalies of about + 10 m d which contrast with the value of - 26 m d in Crooked Island Passage at the top of the slope and with the values found along the part of the Atlantic Coast to the south west of Cape Hatteras by the U S Coast and Geodetic Survey, which are likewise negative, their mean value is - 24 m d We find here an analogous result although somewhat less pronounced, to that found in 1926 by the *K XIII* on the west coast of Central and North America between Panama and San Francisco In the latter case the values above the top of the slope were about normal and those above the foot positive, with a mean value of about 65 m d, the difference between the values above the top and the foot of the slope has the same sign, but is larger on the west coast than on the east coast

Without wishing to enter into a premature interpretation of these results, we may mention two points First, it seems difficult to explain these isostatic anomalies by a different location of the compensation masses from that assumed for the isostatic reduction, so that we appear to be forced to accept a deviation of equilibrium on these coasts Secondly, an explanation of these disturbances of equilibrium on the west

[1] All the anomalies mentioned in this paper have been derived from gravity values which are isostatically reduced according to the method of the U S Coast and Geodetic Survey

coast by a westward drift of the American continent and a corresponding pressure on the ocean floor, seems not in harmony with the results which have now been found on the east coast, in this case the reverse might be expected — a negative anomaly above the foot of the continental slope behind the moving continent

Before and after the expedition, base observations were made with the apparatus both in the gravity base station, Washington, of the U S Coast and Geodetic Survey, and in the Netherlands gravity base station, De Bilt These observations provide, therefore, a new check on the comparison of Washington with the international base station Potsdam The final computations and the application of the final corrections of the time signals have to be awaited before any conclusions will be possible

The expedition has doubtless meant an important step for geodetic and geophysical science because of the immediate results of which a short sketch has been given in this article, but still more because of future possibilities should the U S Navy continue this research Results of great importance and extent might then be expected The expedition has been made possible by the co operation of the U S Navy with the Carnegie Institution and the Dutch Geodetic Commission Sincere thanks may be expressed to the Secretary of the U S Navy, the Hon Curtis D Wilbur, to Admiral Hughes, Chief of Naval Operations, to Admiral Leigh, Chief of the Bureau of Navigation, also to Captain Freeman, Superintendent of the Naval Observatory, for his indefatigable work in preparing the expedition

Personally, I wish to acknowledge the kind reception accorded me everywhere, in Washington, in naval as well as in scientific circles, on board the U S S *S 21* and the other ships, and ashore in the different ports which have been touched, where the naval authorities or, in St Thomas, the Governor of the Virgin Islands, gave me a most cordial welcome

Zoological Exploration of Mongolia

IN the summer, 1928, the Russian Academy of Sciences sent a zoological expedition to Mongolia, under the direction of A Y Tougarinov, who gives a short preliminary account of it in *Priroda*, No 12, 1928 The problem of the expedition was the study of the Mongolian fauna to the east of Urga, a region which so far had not been zoologically investigated The expedition took the route south-east of Urga Plains, with occasional chains of comparatively low mountains, or individual peaks, distinguished by extreme poverty and uniformity of fauna, stretch east of Urga practically to Hingan

The expedition was astonished by the great numbers of *Microtus brandti*, whose colonies stretch for tens of kilometres There are no large mammals, with the exception of rare antelopes, at times colonies of tarbagans were met The characteristic birds are *Haliaeetus leucoryphus*, *Buteo hemilasius*, and the desert larks Such poor landscape stretches up to Hingan, and only after 50 kilometres is a change observed Owing to the humid conditions, the semi desert is gradually transformed into a steppe, the herbaceous carpet is thicker, gramineous plants and other densely leaved steppe grasses are predominant A grassy steppe takes the place of the xerophytic flora. The representatives of desert, such as the sandgrouse, disappear, and dwellers of steppe and forest begin to appear, which shelter in the elm forests of the valley of Chalhin gol Representatives of Manchurian fauna such as *Xanthopygia tricolor*, *Pica sericea*, *Circus melanoleucus* are met with The expedition observed a great flight of birds across Chalhin gol, the species being characteristic of taiga and the tundra of eastern Siberia It may be assumed that here around Mongolia and along Hingan lies the migratory route of east Siberian birds, the origin of which is known to have been in the south east of Asia

Summing up the character of the explored region, it may be said that besides the Mongolian and Manchurian provinces mentioned, the rest of eastern Mongolia may be considered as one district, the chief characteristic of which is the predominance of central Asiatic fauna Series of species characteristic and usual to regions south of Urga are absent (for example, *Podoces hendersoni*, *Accentor fulvescens*, *Emberiza godlewskii*) Their absence cannot always be explained by the lack of suitable habitats The Turanian elements and the forms of the southern Palaearctic are also absent All this leads to the conclusion that recently the country has been exposed to conditions which have impoverished the fauna and hindered the spreading of forms from east and south The extreme desert state and the xerothermic climate were probably the required conditions

University and Educational Intelligence

CAMBRIDGE —Dr N E Goldsworthy, of Clare College, has been elected to the John Lucas Walker studentship for three years This studentship was founded for the furtherance of original research in pathology and is of the value of £300 a year for three years

Smith's prizes have been awarded to H D Ursell, of Clare College and J M Whittaker, of Trinity College Rayleigh prizes have been awarded to J Hargreaves, of Clare College, J G Semple, of St John's College, and S Verblunsky, of Magdalene College

EDINBURGH —At the meeting of the Senatus held on Mar 14, it was announced that His Royal Highness Prince George has consented to visit the University on May 15 to open the new Department of Zoology

At the same meeting the Senatus resolved to offer the honorary degree of doctor of laws to the following among others Prof E S Goodrich, Linacre professor of zoology and comparative anatomy, University of Oxford Prof A V Hill Foulerton research professor of the Royal Society, Prof C E Inglis, professor of mechanics and applied mechanics, University of Cambridge Dr A P Laurie, formerly principal of Heriot Watt College, Sir James Walker, emeritus professor of chemistry of the University of Edinburgh, and the Right Hon Baron Woolavington of Lavington

MANCHESTER —Sir Ronald Ross, Director in Chief of the Ross Institute and Hospital for Tropical Diseases, the discoverer of the life history of malaria parasites in mosquitoes, is among those on whom it is proposed to confer the honorary degree of D Sc on May 15

ST ANDREWS —H R H The Duchess of York has signified her willingness to be present at the opening on June 28 of the Graduation Hall gifted to the University of St Andrews by James Younger, of Mount Melville, St Andrews, and Mrs Younger After performing the opening ceremony, Her Royal Highness will receive the honorary degree of doctor of laws

Prof C E Weatherburn, of Canterbury College, Christchurch, New Zealand, has been appointed to the chair of mathematics in the University of Western Australia.

Applications from medical women are invited for the William Gibson research scholarship, value £292 per annum, and tenable for two years The applications should reach the Secretary, Royal Society of Medicine, 1 Wimpole Street, W 1, by June 1 at latest

The sixth vacation course in terrestrial and aerial photogrammetry will be held at the Technical Physical Institute of the University of Jena on April 8–20 Practical work will be arranged in connexion with the lectures, the necessary apparatus being provided by Messrs Carl Zeiss Particulars can be obtained from A Kramer, Schutzenstr 72 Jena

An election to Beit fellowships for scientific research will take place in July next The latest date for the receipt of applications is April 16 Forms of application and all information respecting the fellowships are obtainable by letter from the Rector, Imperial College of Science and Technology, South Kensington, S W 7

The Board of Education is again prepared to receive applications for full time studentships from teachers of not less than five years' standing, desiring financial assistance in order to attend approved full time courses of advanced study at universities or other institutions at home or abroad The amount of grant will not exceed £100 for an academic year The Board is also prepared to consider proposals involving travel or the practical study of industrial conditions connected with the teaching of technical subjects Applications for the year 1929–30 should be made as soon as possible Further information can be obtained from the Board of Education, Whitehall, London, S W 1

A scientific survey of secondary education in England and the United States has been initiated by the Division of Secondary Education of the University of Pennsylvania with the co operation of committees in both countries The English committee, of which Dr Cyril Norwood (Harrow) is chairman and Mr C W Bailey (Holt School, Liverpool), secretary, met on Mar 9, and in the light of information given by Prof E D Grizzell, of Pennsylvania, who is spending the year in England and has already accomplished much preliminary work, approved a scheme based on the selection of some fifty representative schools Many of the problems confronting secondary education to day are common to both countries, and this joint inquiry should prove helpful The rapid growth since the War in the numbers of schools and pupils has been accompanied by the creation of new types of school and modifications of the old to meet changed conditions, and there has been an enormous amount of research and experimentation in this field, of which the joint survey will doubtless take cognisance Of special interest at the present time are the numerous important researches recently conducted under the auspices of the Iowa Research Conference on Commercial Education, the survey of secondary commercial education in Minnesota and other studies, described in the report for 1927–28 of the United States Commissioner of Education, designed to contribute to improvement of instruction in commercial departments of secondary, normal, and collegiate schools

Calendar of Patent Records

March 24, 1802 —To Richard Trevithick, one of the greatest of British engineers and inventors, we owe the introduction of the high pressure steam engine, a patent for which was granted to him, in conjunction with Andrew Vivian, on Mar 24, 1802 The specification describes also a steam carriage to which at that time Trevithick attached considerable importance though he abandoned it after a few years of not very successful experiment The first locomotive to run on a railway was, however, the outcome of these experiments This was constructed by Trevithick, and ran at the Pen y darren Iron Works near Merthyr Tydfil for a few months in 1804

March 25, 1840 —The commercial success of electro silver plating was founded on the patent granted to George Richard Elkington and Henry Elkington, of Birmingham, on Mar 25, 1840 The idea of using the double cyanide of silver and potassium was due to John Wright, a Birmingham surgeon, who had been working independently in the same field, and, arriving in London to secure patent rights for his process, met George Elkington, then engaged on the preparation of his patent specification The two agreed to work together, and on the satisfactory demonstration of Wright s process, this was incorporated into the Elkingtons' specification

March 27, 1886 —The first commercial process to utilise successfully the action of diastase on starch in breadmaking was employed in the making of 'Bermaline' bread, under a patent which was granted to John Montgomerie of Lanark on Mar 27, 1886

March 28, 1764 —A step was taken towards the machine production of lace by the patent granted to Thomas Morris and others on Mar 28, 1764, for a new machine which is to be fixed to a stocking frame for making oilett holes or network in silk, thread, cotton, or worsted, as mitts, gloves, hoods, aprons, handkerchiefs, and other goods manufactured on stocking frames" The idea of the new machine seems first to have occurred to a stocking maker of Mansfield named Butterworth, who, with the object of having a machine made, confided it to John Betts, a smith Betts, however, obtaining financial support from Thomas and John Morris, hosiers, of Nottingham, took the invention to London, where the patent was granted in the joint names of the Morrises and Betts The patent was afterwards assigned to John Morris, and the invention was successfully applied in Nottingham, the knitting industry of which reaped considerable benefit from its introduction

March 28, 1787 —During the last few years of the eighteenth century, many experiments were made in England, America, and France in the application of the steam engine to navigation Amongst these, and the first to receive a practical trial in the United States, was the invention of John Fitch, who was granted a patent by special Act of Assembly for the State of Pennsylvania on Mar 28, 1787 A steam-boat, according to Fitch s specification, moved by twelve oars or paddles working perpendicularly after the manner of the paddle of a canoe, six paddles entering the water as the remaining six are raised, was built in Philadelphia, and ran on the River Delaware in 1788 carrying more than thirty persons a distance of 20 miles in 3 hours 10 minutes

March 28, 1907 —The control pillar or 'joy stick' in almost universal use in aeroplanes was the invention of Robert Esnault Pelterie, who was granted a French patent on Mar 28, 1907, in which an aeroplane with warping wings and elevators controlled by one lever was for the first time described A corresponding English patent was applied for in January 1908

Societies and Academies

LONDON

Institute of Metals, Mar 13 —**P Saldau** Special properties of eutectics and eutectoid alloys in binary metallic systems As regards hardness and electrical resistance, the eutectic occupies an abnormal position on the property composition curve, even in drastically annealed alloys For coalescence to occur, an excess of one of the phases is necessary —**F Hargreaves** and **R J Hills** Work softening and a theory of inter crystalline cohesion For work softening there must be more than one phase present and, roughly, *both* constituents must undergo spontaneous annealing after working at air temperature A theory of inter crystalline cohesion is outlined Briefly, it postulates the existence of a transition zone between two orientations Work hardening and work softening are identical phenomena concerning the early stages of the latter The pronounced softening caused by heavy working is attributed to interphase boundary action and the retention of the individual phases in a quasi viscous condition —**P J Durrant** The *constitution of the cadmium rich alloys of the system cadmium gold* The constitution of the alloys of cadmium and gold from 0 to 48 atoms per cent of gold has been reinvestigated by thermal and micro graphic analysis Saldau's equilibrium diagram, published in 1915, has been modified A new area of solid solution has been detected (phase III) which lies in the field described by Saldau as containing $\beta + \gamma$ This solid solution undergoes two polymorphic changes—one at about 500° C, and the other at about 375° C, the latter being analogous to the change in the β phase of brass at 460° C No evidence was obtained for the existence of the compound $AuCd_3$ at the liquidus, but the form of the equilibrium diagram suggests the existence of two compounds, Au_2Cd_5 and Au_4Cd_3, both of which are much dissociated at high temperatures —**Marie L V Gayler** and **G D Preston** The age hardening of some aluminium alloys Five typical aluminium alloys containing copper, magnesium silicide, or both, have been examined Changes in density and lattice parameter which take place during ageing suggest that precipitation from solid solution takes place X ray analysis shows also that the crystals themselves are in a disturbed state, which is gradually relieved by further ageing at high temperatures The increase in electrical resistance on ageing corresponds to this distortion of the space lattice of the solid solution, caused by the presence of minute particles due to the decomposition of the solid solution — **Clement Blazey** Brittleness in arsenical copper (2) Under certain conditions, about 0 004 per cent of bismuth can produce a susceptibility to brittleness The conditions are plain melting under charcoal of arsenical copper of the quality used, followed by poling and the addition of bismuth before casting The addition of phosphorus after bismuth destroys the susceptibility or it may be removed by remelting —**W Hume-Rothery** and **E O Rounsefell** The system magnesium zinc The equilibrium diagram of the system magnesium zinc has been investigated in the range 0 to 70 atomic per cent magnesium Particular attention has been paid to the structure of the solid alloys and the limits of solid solution in the various phases The compound $MgZn_2$, discovered by Chadwick, and $MgZn_5$, discovered by Grube, have been confirmed A new compound, $MgZn$, has been shown to exist, and this also is of fixed composition It may be distinguished from $MgZn_2$ by means of Benedicks' reagent The compound is formed at 354° C by a peritectic reaction between $MgZn_2$ and liquid On the practical side, the present work shows that in elektron metal, and similar alloys, any zinc present in excess of that contained in solid solution in magnesium will exist in the form of the new compound MgZn, and not, as previously supposed, as $MgZn_2$

Geological Society, Feb 20 —**C A Matley** The basal complex of Jamaica, with special reference to the Kingston district With petrological notes by **F Higham** There is a basal complex of great thickness, unconformably underlying Upper Cretaceous and Eocene rocks The 'granite and syenite' of the Survey—chiefly a granodiorite—is an important plutonic member of the complex, and contributes abundant pebbles to overlying Upper Cretaceous and Eocene conglomerates Another plutonic member of the complex is a peridotite of Harzburg type, now converted to serpentine The other members of the complex, many of which are found in a metamorphic condition, were originally sediments and volcanic lavas and tuffs The metamorphism appears to be late Palæozoic (Hercynian) or even older No trace of fossils has been found in the complex Comparison is made with similar rocks in Cuba, Hispaniola (Haiti and Santo Domingo) Porto Rico, and the Virgin Islands With the exception of Porto Rico, Jamaica now falls into line, as regards the presence of a pre Cretaceous basement, with the other islands of the Greater Antilles, although there is still want of agreement as to the ages of the rocks of that basement

Physical Society, Mar 8 —**Ezer Griffiths** and **J H Awbery** The dependence of the mobility of ions in air on the relative humidity The apparatus employed was a modification of Zeleny's original method, the end of a wind channel being closed by a disc of gauze fitted with a guard ring through which a steady stream of air of definite humidity was pumped The motion of the negative ions due to the action of the air stream was balanced by a counter potential gradient, and the mobility deduced from the critical potential required to produce a balance

LEEDS

Philosophical and Literary Society, Feb 19 —**W P Milne** Three theorems on the cubic surface —**A O Allen** A simplified derivation of v Seidel's aberration formulæ —**W H George** X ray examination of insulin, edestin, and hæmoglobins Only the powder method could be applied **G W Brindley** Distribution of charge on the carbon atom The F curve calculated for the carbon atom model does not agree quantitatively with the experimental curve The disagreement is most noticeable for large values of $\sin \theta$ for which the theoretical curve is known with most certainty —**H M Dawson** and **G Claxton** The miscibility of phenol with aqueous solutions of electrolytes If S and C represent the molar concentrations of the phenol and the electrolyte in the aqueous phase, then for a wide range of C values the experimental results are accurately reproduced by the formula $S = S_0 C^{kc}$, where S_0 is the value of S for $c = 0$, and k is a constant which varies with the nature of the electrolyte The results suggest that the miscibility is not appreciably affected by the interionic forces which are associated with the presence of the salt —**C K Ingold** and **H Burton** The existence and stability of free radicals The basis of the theory is the principle of electronic exclusion, which is also regarded as the radical cause of tautomerism —**W H Pearsall** Form variation in *Ceratium Hirundinella* O F M Statistics as to its variation in size and form in Rostherne Mere support the view that the

population is composed of a single race of this species The form variation shows three phases, and an explanation of the changes in size is advanced, based on the differential rates of protoplasmic growth and cell wall formation —**R G S Hudson** On the lower carboniferous corals *Orionastræa* and its distribution in the north of England The northern forms, with the exception of those from the D_2 zone, belong to other groups than that of *Orionastræa phillipsi* or *O placenta* and have therefore been described as new species and a structural sequence established

PARIS

Academy of Sciences, Feb 11 —**G Charpy and L Jacque** The reduction of the sulphates of the alkaline earths in metallurgical operations From the experiments described it is concluded that although it may be true that in certain metallurgical operations barium sulphate does not introduce so much sulphur into the casting as calcium sulphate, this is not due to a difference in the chemical properties of the two sulphates but to certain physical peculiarities more especially the fusibility of the slag — **A Khintchine** The law of large numbers — **S Serghiesco** The number of roots common to several simultaneous equations **Charron** A curious gyroscopic phenomenon —**E Huguenard and A Magnan** An apparatus for the comparison of aerodynamical velocities round an aeroplane —**Dussaud** Apparatus for the blind — **A Auric** The ring of asteroids An examination of the distribution of the asteroids with respect to their distance from the sun leads to the conclusion that the asteroids do not constitute one homogeneous family but a mixture of two families differing in their origin and their constitution The study of the distribution of the eccentricities and the inclinations of the orbits leads to the same conclusion —**Thadée Banachiewicz** The ellipticity of the terrestrial equator —**Z Horàk** The wave equation of Schrödinger —**Vasilesco Karpen** The equations of state and thermodynamics Reply to some criticisms by M Verschaffelt **B Decaux** The measurement of very high radiotelegraphic frequencies by means of piezo electric quartz oscillators —**A Travers and Nouvel** The solubility of $Mg(OH)_2$ at high temperatures Special attention was given to the preparation of a pure magnesium hydroxide, and in the experiments at high temperatures glass vessels were replaced by copper flasks The solubility becomes inappreciable at 178° C — **Lespieau** A heterocyclic diacetylene derivative The interaction of the dimagnesium compound of acetylene on symmetrical dichlormethyl ether gives rise to a substance the properties of which are consistent with the formation of a ring compound with eight carbon atoms and two oxygen atoms in the ring —**L Blanchard** Some derivatives of cyclobutanol —**Henri Moureu** The tautomerism of the α diketones The two tautomeric forms of phenylbenzylglyoxal and of phenylanisyl glyoxal —**L Meunier and R Guyot** The absorbent properties of cellulose fibres after treatment with formol in acid solution —**J Savornin** The artesian hydrogeology, hydraulics, and thermodynamics of the eastern Sahara —**Ch Killian** The development and biology of *Ambrosinia Bassii* —**P J Shiwago** The chromosome complex of the chicken and turkey — **Jules Lefèvre** Bioenergetics and its new laboratory — **C Levaditi and P Lépine** Experimental herpetic encephalitis of the ape

PRAGUE

Czech (Bohemian) Academy of Arts and Sciences (2nd class, Natural Sciences and Medicine), Jan 11 — **F E Vološin** A new ice pyrheliometer — **F Čechura** Magnetic declination in Bohemia in 1925 5 The following communications of members of the 2nd class of the Academy were presented to be incorporated in a jubilee volume in commemoration of the tenth anniversary of the foundation of the Czechoslovak Republic —1 **B Brauner** Some physiologico optical experiments — 2 **B Bydžovský** Symmetric involutions of the fifth order —3 **E Čech** Asymptotic correspondences between two surfaces —4 **K Domin** The hybrids and the garden forms of the genus *Pityrogramma* — 5 **J Hanuš, A Jílek, and J Lukas** Para brom benzol aceton its iso nitroso compound and dioxime —6 **J Hanuš and J Voříšek** The action of hydrazine hydrate on some unsaturated acids of the series $C_nH_{2n-2}O_2$, $C_nH_{2n-4}O_2$, $C_nH_{2n-6}O_2$ —7 **F Hasa** The quality of butt and molten electrical weldings — 8 **J Heyrovský and S Berezicky** The deposition of radium and other alkaline earth metals at the dropping mercury cathode —9 **I Honl-Ungarn** Properties of bacteriophages —10 **R Kettner and F Slavík** A new profile in Algonkian and Cambrian of Tejřovice — 11 **J Křepelka** A study of perselenic acid 12 **V Láska** Hyetometry in mountainous countries 13 **B Němec** Immunity in plants 14 **M Pelíšek** Space rolling of a hyperbola on a congruent hyperbola 15 **J Pelnář** The cancer of *Micterus* and our clinical experience —16 **K Petr** The composition of binary quadratic forms —17 **V Posejpal** Resonance spectra and the Raman effect — 18 **C Purkyně** The Carboniferous and Permian formations in western outskirts of Krkonoše (Giant's Mountains) —19 **V Rosický** Two articles on the study of crystal properties —20 **K Rychlík** The extension of the idea of congruence — 21 **J Štěrba-Böhm and S Škramovský** Complex oxalates of scandium —22 **V Trkal** The equation of the wave propagation in the wave mechanics and Hamilton s principle 23 **J Vilhelm** Verdant and proliferous flowers of some plants — 24 **E Votoček-V Prelog** The 3, 12 di hydroxy palmitic acid, a non sugar component of rhamno convolvulic acid —25 **K Weigner** Physical education respecting constitution and sex —26 **J Wenig** The structure of secondary envelopes of chords in *Ammocetes* —27 **J Wenig** A peculiar phenomenon in the abnormal growths of incisor teeth of Rodentia — 28 **F Záviška** The translation of circular cylinders through a viscous liquid

Feb 8 —**J Paroulek** The action of liver and ligamentic tissues on the exogenic uric acid —**J Scheiner** The lipoid nephrose —**V Jedlička** The pathogenesis and etiology of pernicious anæmia — **S Prát and Z Kobza** The chemical composition of some Algæ **J Babička** The Bohemian Travertins —**B Brauner** Analysis of water from the pond 'Babylon'

WASHINGTON, D C

National Academy of Sciences (*Proc*, Vol 14, No 12, Dec 15) —**Raymond Pearl, Charles P Winsor, and Florence Barclay White** The form of the growth curve of the canteloup (*Cucumis melo*) under field conditions The growth of seedlings of this plant in the field as in the laboratory, without exogenous food and light, can be represented by a generalised logistic curve The experiments suggest that, to a first approximation, the rate of growth is identical whether the environment is constant or highly varied, that is, it is determined by the organism itself Food from the soil, etc is only a means of prolonging its life — **E T Bell** Invariant sequences —**A Adrian Albert** (1) Normal division algebras satisfying mild assumptions —(2) The group of the rank equation of any normal division algebra —**Morgan Ward** Postulates for an abstract arithmetic —**Einar Hille and J. D**

Tamarkin (1) On the characteristic values of linear integral equations —(2) On the summability of Fourier series — **G A Miller** Groups involving a cyclic, a dicyclic, or a dihedral group as an invariant subgroup of prime index — **Ancel B Keys** The weight length relation in fishes It is shown statistically that this relation is given by {weight = constant × (length)^n}, where n is between 3 and 4 The form of a fish changes during growth, and the paper gives a method of calculating the magnitude of the change – **Gordon D Snell** A cross over between the genes for short ear and density in the house mouse The detection of one cross over shows that the genes for short ear and density, although borne in a common chromosome are not at identical loci — **Mildred S Moses** and **Chas W Metz** Evidence that the female is responsible for the sex ratio in *Sciara* (Diptera) Breeding shows that certain females are female producers and others male producers regardless of males with which they mate, fertilisation being by the first male used in mating —**Chas W Metz** and **Mildred S Moses** Observations on sex ratio determination in *Sciara* (Diptera) Sex ratio is probably determined by a simple Mendelian inheritance of a single pair of factors for which female producing females are heterozygous and male producing females and males are homozygous and recessive – **John Warren Williams** The relation between polarisation and association A development of Debye's theory that association in liquids depends on the interaction of the dipoles — **L W Elder, Jr**, and **W H Wright** pH measurement with glass electrode and vacuum tube potentiometer A quadrant electrometer is generally used with the glass electrode for electrometric work with substances affected by platinum A vacuum tube potentiometer gives consistent results and the only precaution necessary is that it must be set up in a dry atmosphere –**Carl Barus** Chemical reaction in the interferometer U gauge —**P W Bridgman** Resistance and thermo electric phenomena in metal crystals By an improved method of making single metal crystals, it has been possible to cast from the same melt a number of single crystal rods of a wide range of orientation The general results indicate that the Kelvin Voigt symmetry law for thermal e m f is an approximation The detailed paper is to appear in *Proc Am Acad Sci* **Ronald W Gurney** Angular distribution of intensity of resonance radiation It has been assumed that the emission of resonance radiation will be distributed at random in direction, this assumption seems to be unwarranted If the plane of polarisation of plane polarised light is rotated rapidly, consideration of the movement of the atomic oscillators shows that though the intensity along the beam is unaltered, in other directions it is modified This must be taken into account in intensity measurements of resonance radiation —**Stanley Smith** Some multiplets of singly ionised thallium – **J D Hanawalt** The influence of the presence of hydrogen on the L III X ray absorption edge of palladium Whether the hydrogen is occluded electrolytically or in a hydrogen furnace, there is X ray evidence of the presence of the chemical compound of formula Pd_2H, with a face centred cubic lattice in which alternate grating points are PdH molecules, the remaining points being occupied by Pd atoms —**Harlow Shapley** Studies of the galactic centre (3) The absolute magnitudes of long period variables – **B P Gerasimović** The absolute magnitudes of long period variable stars A period luminosity relation is obtained for a period of 100 250 days, mean absolute visual magnitude is −2 3, for a period of 250 340 days it is −1 1, and for a period greater than 340 days it is +0 3

Official Publications Received

BRITISH

Memoirs of the Asiatic Society of Bengal Vol 11 No 1 Diaries of Two Tours in the Unadministered Area east of the Naga Hills By J H Hutton Pp 72+16 plates (Calcutta) 11 13 rupees

The Indian Forest Records Silviculture Series Vol 13 Part 3 Commercial Volume Tables for Sal (*Shorea robusta*) in the Wet Mixed Forests of the *Bengal Duars* By Tarun Nand Suri Pp ii+25+2 plates 6 annas 8d Silviculture Series Vol 13 Part 4 Volume Tables for *Sundri* (*Heritiera Fomes* Buch Syn *Heritiera minor* Roxb) in the Sundarbans Bengal By Tarun Nand Suri Pp ii+4?+? plates 10 annas 1s (Calcutta Government of India Central Publication Branch)

Memoirs of the Geological Survey of India Palaeontologia Indica New Series Vol 9 Memoir No 2 Revision of the Jurassic Cephalopod Fauna of Kachh (Cutch) Part 3 By Dr L F Spath Pp 161 278+plates 20-47 (Calcutta Government of India Central Publication Branch) 15 4 rupees 24s 6d

Empire Cotton Growing Corporation Reports received from Experiment Stations 1927–28 Pp xii+?8+12 plates (London)

Geological Survey Department Tanganyika Territory Short Paper No 1 Outlines of Geology of the Regions adjoining the South Eastern Shores of Lake Victoria By F B Wade Pp iv+24+1 map Short Paper No ? Lupa Gold Field By Dr D R Grantham Pp ii+6+2 maps Short Paper No 3 Kigugwe Copper Deposit near Bandika By G M Stockley Pp ii+8+1 map Annual Report 19 Pp 10+2 maps 5s (Dar es Salaam Government Printer)

Department of Agriculture Tanganyika Territory Pamphlet No 3 Tea Cultivation By M F Bell Pp 1?+1 plate Tea Planting Prospects in the South Western Highlands of Tanganyika By M F Bell Pp ii+8? (Dar es Salaam Government Printer)

Institute of Physics The Presidential Address on Physics in Astronomy given before the Institute on May 1, 1928 Pp 15 1s net The Physicist in the Glass Industry given before the Institute of Physics on May 25 1927 By Prof W E S Turner (Physics in Industry Lecture No 12) Pp ??+6 plates 1s net Physics in the Food Industry given before the Institute of Physics on November 11 1927 By Sir William Hardy (Physics in Industry Lecture No 13) Pp 21+? plates 1s net The Physics of Photography given before the Institute of Physics and the International Congress of Photography on July 1928 By Dr C E Kenneth Mees (Physics in Industry Lecture No 14) Pp 20+1 plate 1s net (London)

Proceedings of the Royal Society of Edinburgh Session 1928 1929 Vol 49 Part 1 No 1 The Theory of Bigradients from 1861 to 1911 By Sir Thomas Muir Pp 1 1s 3d Vol 49 Part 1 No 2 Mathematical Consequences of certain Theories of Mental Ability By John Mackie Pp 16-37 2s Vol 49 Part 1 No 3 On a Quadrature Formula for Trigonometric Integrals By Prof L N G Filon Pp 38 47 1s Vol 49 Part 1 No 4 The Fulcher Bands of Hydrogen By Dr Ian Sandeman Pp 48 64 1s 6d (Edinburgh Robert Grant and Son London Williams and Norgate Ltd)

Pharmaceutical Society of Great Britain Pharmacological Laboratories Third Annual Report 1928 Pp 19 (London)

Proceedings of the Cambridge Philosophical Society Vol Part 1 January Pp 120 (Cambridge At the University Press) 7s 6d net

Students from other Countries in the Universities and University Colleges of Great Britain and Ireland Session 1928 Pp 38 (London Universities Bureau of the British Empire) 1s

Leeds Public Libraries What to Read on Zoology By Prof J Arthur Thomson Pp 80 9d What to Read on Biology By Prof William John Dakin Pp 32 8d (Leeds)

The South African Journal of Science Vol 25 Being the Report of the Twenty sixth Annual Meeting of the South African Association for the Advancement of Science Kimberley 1928 ?0 June to July Pp xliv+5?6 (Johannesburg) 30s net

The Imperial College of Tropical Agriculture Prospectus for 1929 30 also Principal's Report for 1927 28 and Register Pp 38+? plates (St Augustine Trinidad and London)

Air Ministry Aeronautical Research Committee Reports and Memoranda No 1171 (Ae 335) The Theoretical Relations for an Aerofoil with a Multiply Hinged Flap System By W G A Perring (T 2632) Pp 14+8 plates 9d net No 1174 (Ae 338) Wind Tunnel Tests with High Tip Speed Airscrews Some Experiments upon an Airscrew of Conventional Blade Section Aerofoil R and M 322 No 3 at High Speeds By Dr G P Douglas and W G A Perring (T 2077) Pp 8+4 plates 9d net No 1176 (Ae 340) The Boundary Layer of the Front Portion of a Cylinder By Dr A Thom (T 3 and A) Pp ?0+7 plates 1s net No 1180 (Ae 344) The Inclusion of Partial Glides in Routine Performance By A. E Woodward Nutt (T 2626) Pp 8+2 plates 4d net No. 1182 (Ae 346) Rolling Experiments on an Aerofoil of R.A.F 32 Section By H B Irving and A. S Batson (T 2640) Pp. 8+3 plates 6d. net. (London H M Stationery Office)

FOREIGN

Meddelanden från Statens Meteorologisk Hydrografiska Anstalt Band 4 No 7 De svenska vattendragens arealförhallanden Ångermanälven och Indalsälven m fl (Vattendragen mellan umealva och ljungans områden) Av Gustaf Wernén Pp 24 2 50 kr Band 4 No 10 Tåkern en hydrografisk Undersökning Av Ragnar Melin Pp ?2 +6 planscher 5 00 kr Band 5 No 1 Väderlekens samband med Hälsotillståndet. Av Axel Wallén Pp 71 3 00 kr Band 5 No 2 Eine neue Methode zur Bestimmung des Wassergehaltes der Wolken Von Hilding Köhler Pp 11 1 00 kr (Stockholm)

Abisko Naturvetenskapliga Station Observations météorologiques à Abisko en 1926 Rédigées par Bruno Wolf Pp. iv+66 Observations météorologiques à Abisko en 1927 Rédigées par Bruno Wolf Pp vi+66 (Uppsala Almquist and Wiksells Boktryckeri A B)

University of California Publications in American Archaeology and Ethnology Vol 23, No 10 Dental Pathology of Aboriginal California By R. W Leigh Pp 399 440+plates 60-67 (Berkeley Calif University of California Press London Cambridge University Press.) 50 cents.

Wisconsin Geological and Natural History Survey Bulletin No. 69 Economic Series No 28 Molding Sands of Wisconsin By David W Trainer Jr Pp 106 (Madison Wis)

The University of Chicago Publications of the Yerkes Observatory Vol 4 Part 7 Astrometric and Photometric Statistics of certain of Hagen's Fields photographed with the 24 inch Reflector By Harriet McWilliams Parsons Pp v+82+plates 8 9 (Chicago University of Chicago Press London Cambridge University Press) 7s. 6d net

Scientific Papers of the Institute of Physical and Chemical Research. No 172 The Slip-Bands produced when Crystals of Aluminium are Stretched Part 2 Extension at High Temperatures. By Keiji Yamaguchi and Sakuichi Togino Pp 277 292 (Tokyo Iwanami Shoten) 30 sen

Carnegie Institution of Washington Annual Report of the Director of the Department of Terrestrial Magnetism (Reprinted from Year Book No 27 for the year 1927 28.) Pp 208 267 (Washington, D C)

The Science Reports of the Tôhoku Imperial University Sendai Japan Second Series (Geology) Vol 12 No 1 Pp 152+28 plates (Tokyô and Sendai Maruzen Co Ltd)

Proceedings of the United States National Museum Vol 74 Art 18 Bathnopterus, a new Fossil Gasteropod Genus from the Silurian of Alaska By Edwin Kirk (No 2766) Pp 4+1 plate (Washington D C Government Printing Office)

Proceedings of the California Academy of Sciences Vol 18 No 1 A new Species of Coramba from the Pacific Coast of North America By Frank M Macfarland and Charles H O Donoghue Pp 27+3 plates Vol 18 No 2 A new Bird Family (Geospizidae) from the Galapagos Islands By Harry S Swarth Pp 29 43 Vol 18 No 3 A Contribution to our Knowledge of the Nesting Habits of the Golden Eagle By Joseph R Slevin Pp 4 71+plates 4 7 (San Francisco Calif)

Journal of the Faculty of Science Imperial University of Tokyo Section 1 Mathematics Astronomy Physics Chemistry Vol 1 Part 11 Pp 417 437 0 60 yen Section 2 Geology Mineralogy Geography Seismology Vol 2 Part 7 Pp 331 812+plates 66-69 1 00 yen Section 4 Zoology Vol 1 Part 1 Pp 49+8 plates 1 70 yen (Tokyo Maruzen Co Ltd)

Proceedings of the American Academy of Arts and Sciences Vol 63, No 5 A new Equation of State for Fluids By James A Beattie and Oscar C Bridgeman Pp 229-308 1 45 dollars Vol 63 No 6 The Electrical Resistance of Alloys under Pressure By C W Ufford Pp 309 328 60 cents Vol 63 No 7 The Effect of Pressure on the Resistance of Three Series of Alloys By P W Bridgman Pp 329 345 45 cents Vol 63 No 8 The Compressibility and Pressure Coefficient of Resistance of Zirconium and Hafnium By P W Bridgman Pp 347 350 30 cents (Boston Mass)

Rendiconti del Seminario Matematico e Fisico di Milano Vol 2 (1928—VI) Pp xii+ 90 (Milano)

Journal of the Faculty of Agriculture Hokkaido Imperial University Sapporo Japan Vol 24 Part 2 Influence of Ultra violet Ray upon the Milking Cow By Kenzo Iguchi and Kentaro Mitamura. Pp 59 60 (Tokyo Maruzen Co Ltd)

Department of the Interior Bureau of Education Bulletin 1928 No 15 Educational Achievements of One Teacher and of larger Rural Schools By Timon Covert Pp v+28 (Washington D C Government Printing Office) 5 cents

Proceedings of the United States National Museum Vol 74 Art 22 Two new Frogs from Jamaica By Emmett Reid Dunn (No 2707) Pp 2 (Washington D C Government Printing Office)

Calendario del Santuario e delle Opere di Beneficenza Cristiana di Pompei 1 929 Pp 6+32 (Pompei)

CATALOGUES.

Entomologia (Neue Werke). No 74 Pp 56 (Berlin W Junk)

A Rough List of Recent Purchases of Valuable Books on Zoology Botany the Physical and Mathematical Sciences Sport etc (New Series No 22) Second Portion. Pp 61 108 (London Wheldon and Wesley Ltd)

Engineering and Industrial Instruments (List E5) Pp 460 (London Negretti and Zambra)

Books and Measures for the Timber Plywood Pulp Paper Cabinet and Furniture and Woodwork Trades Pp 16 (London Stobart and Son)

Diary of Societies

FRIDAY March 22

Institution of Naval Architects (Annual Meeting) (at Royal Society of Arts), at 11 —Eng Rear Admiral W Scott-Hill Powdered Coal for Ships —A Spyer Modern Developments of the Water Tube Boiler for Marine Purposes —Eng Rear Admiral A E Hyne Suggested Modifications to Marine Water Tube Boilers —At 8 —J Bennie Barnett Motor Life Boats of the Royal National Life Boat Institution.

Textile Institute (Lancashire Section) (at Manchester), at 1 15.—J W Cooling Air Conditioning Apparatus including Humidifying and De Humidifying

North of England Institute of Mining and Mechanical Engineers (Associates and Students Section) (Newcastle upon Tyne) at 2 30 — J T Whetton The Optics of Surveying Instruments and Tacheometric Surveying —Paper open for further discussion —The Lubrication of Colliery Coal Tubs by L H Forster

Royal Society for the Protection of Birds (Annual Meeting) (at Middlesex Guildhall Westminster), at 3 —Col. Sir George Courthope Bart. The Economic Value of Wild Birds

Royal Society of Medicine (Disease in Children Section) (Clinical Meeting at Royal Free Hospital), at 4 30

Physical Society (Annual General Meeting) (at Imperial College of Science), at 5 —Dr W H. Eccles Presidential Address

Royal College of Surgeons of England, at 5 —Sir Arthur Keith Demonstration on the Nerve Supply and Movements of the Colon.

Institution of Civil Engineers (Birmingham and District Association) (at Chamber of Commerce Birmingham), at 6 —A Page The Development of the Generation and Distribution of Electricity in the British Isles

Institute of Marine Engineers, at 6.30.—Annual General Meeting

Institution of Locomotive Engineers (North Eastern Centre) (at Hotel Metropole Leeds) at 7 —T Robson Experiments on Buffer Springs.

Royal Photographic Society of Great Britain at 7 —H Lambert Warm Tones on Chloro Bromide Papers.

West of Scotland Iron and Steel Institute (Annual General Meeting) (at Royal Technical College Glasgow), at 7 —F G Martin Elastic Limit Steel

Blackburn Textile Society (at Blackburn Technical College), at 7 30 — A J Hall The Dyeing and Finishing of Cotton Piece Goods containing Artificial Silk

Leicester Textile Society (at Victoria Hall Leicester), at 7 30 — S Kershaw Faults in Yarns.

Junior Institution of Engineers (Informal Meeting) at 7 30 — D A. Collin Ventilation

Royal Institution of Great Britain at 9 —Sir Ernest Rutherford Penetrating Radiations

SATURDAY March 23

Royal Institution of Great Britain at 3 —Sir Ernest Rutherford Molecular Motions in Rarefied Gases (IV).

MONDAY March 25

Institution of Mechanical Engineers at 6 30 —Wing Comdr T R. Cave Browne Cave Aircraft Engineering in its Relation to Mechanical Engineering (Annual Lecture)

Institution of Electrical Engineers (North Eastern Centre) (at Armstrong College, Newcastle upon Tyne), at 7 —Hon Sir Charles A Parsons and J Rosen Direct Generation of Alternating Currents at High Voltages.

Institution of Electrical Engineers (South Midland Centre) (at Birmingham University) at 7 —J Wright and C W Marshall The Construction of the Grid Transmission System in Great Britain

Society of Chemical Industry (Glasgow Section) (at Royal Technical College Glasgow), at 7 30 —J R. Campbell The Activity of Various Catalysts in Promoting the Oxidation of Methane by Means of Oxygen —W J Skilling and E D Ballantine A Simple Method for the Determination of Phosphorus in Coal Ash

Hunterian Society of London at 7 30 —Drs H Daily E Obermer and T Grey Discussion on Blood Pressure in Health and Disease.

Royal Society of Medicine (Odontology Section) at 8 —C H Howkins The Dental Aspects of Radium Treatment.—J B Parfitt A Compound Composite Odontoma

Royal Geographical Society (at Polytechnic Regent Street) at 8 30 — Sir Douglas Mawson Recent Work on the Fjords of New Zealand

Medical Society of London at 8 30 —E Holland Dr B T Parsons Smith, and Dr B Hart Medical Indications for the Induction of Abortion and Premature Labour

Todmorden Textile Society (at Todmorden).—Mr Bentley Cardroom Processes

TUESDAY March 26

Royal Society of Arts (Dominions and Colonies Meeting), at 4 30 — H Warington Smyth The Base Metal and Mineral Resources of South Africa

Royal College of Physicians of London at 5 —Dr R. A Young A Medical Review of the Surgery of the Chest (Lumleian Lectures) (III)

Royal Aeronautical Society (at 7 Albemarle Street) at 5 30 —Annual General Meeting

Institution of Electrical Engineers (North Midland Centre) (at Hotel Metropole Leeds) at 7 —B L Goodlet The Testing of Porcelain Insulators

Royal Photographic Society (Scientific and Technical Group) (Annual General Meeting) at 7 —Dr F C Toy How it Works in Photography

Royal Anthropological Institute, at 8 30 —C Lucas The Nature of the Colour of Pottery with Special Reference to that of Ancient Egypt

Manchester Athenæum Textile Society (at Manchester).—T Hunt and Dr E R Cooper Life and Conditions in a Modern Spinning Mill

WEDNESDAY March 27

Royal Society of Medicine (Comparative Medicine and Neurology Sections) at 5 —Special Discussion on Encephalo-myelitis of Man and Animals I A. Galloway (Comparative Medicine) Dr J G Greenfield (Neurology) Other speakers Dr W Russell Brain Dr T Hare I P Pugh and others

Newcomen Society for the Study of the History of Engineering and Technology (at 17 Fleet Street), at 5 30 —W A Benton John Wyatt and the Weighing of Heavy Loads.

Institution of Civil Engineers (Students Meeting) at 6.30 —D H Little Roads.

Royal Philosophical Society of Glasgow (at 207 Bath Street, Glasgow) at 8.—Dr F Fargus Vision and Industrial Efficiency

Institute of the Rubber Industry (at Glasgow).—Dr Daynes Methods and Appliances used in the Control of some Manufacturing Processes in the Rubber Industry

PUBLIC LECTURE.

SATURDAY March 23

Horniman Museum (Forest Hill) at 3 30 —M A. Phillips Mammals of Britain

SATURDAY, MARCH 30, 1929

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Petrol

THE problem of petrol arises in acute form once again, and the lay mind is finding it difficult to reconcile continually increasing production of crude oil with, apparently, a directly proportional rise in price of its most valuable derivative As a purely economic consideration, petrol is not exactly a straightforward commodity to assess in terms of supply and demand, for the simple reason that this usually close relationship does not in this particular case express the condition of the oil industry at any time When complicated by conflicting commercial and political issues, these confined to no one country, it is small wonder that a number of the less obvious controlling factors in the situation fail to be appreciated by the public at large

From the technical aspect, the data of the problem are quite clear Of a total world production in 1928 of crude oil amounting to 182 million tons, the United States accounted for 127 millions, nearly 70 per cent, Venezuela, the next on the list, yielded 15 million tons, about 8 per cent, Russia contributed 11½ million tons, or about 6 per cent, Mexico, 6½ million tons, about 3 per cent and Persia, the oil industry of which figures especially prominently in contemporary discussions in the British press, produced 5 million tons, or 2½ per cent (the figures are approximate) Thus all the remaining countries combined account for only 10 per cent of the total output, and the United States persists as the dominating factor in the industry, so far as resources and exploitation are concerned Incidentally, in spite of local 'proration' agreements, that country continues to flood the market with some 385,000 tons of crude oil per day, a steadily rising figure Statistics can, of course, be made to prove practically any thing, but a sense of proportion born of a grasp of these data is the first step in understanding the present petrol situation

So many tons of crude oil output, however, do not constitute the barometer of the industry As E H Davenport has recently shown in a pamphlet entitled "The Price of Petrol" (London General Press), in order to appreciate the true economic position, the supply demand relationship of other important derivatives of crude oil must be ascertained, since petrol is only one of a series of vital products to modern civilisation

Now excluding paraffin and lubricants, fuel oil, a heavy residuum from crude oil distillation, has its own particular scheme of economics Apart

from its enhanced use as a basis of 'cracked' derivatives, it is essentially this oil of which we hear so much in competition with coal By no means an unimportant influence in the present petrol 'crisis' is this very item fuel oil, the market vicissitudes of which operate directly in response to fluctuations of coal supply and demand There is a great deal of nonsense written about the antagonistic purposes of oil and coal, but one thing is abundantly clear the two commodities, in so far as supply and demand are concerned, are as sensitively balanced in the world of fuel as any delicately poised beam in a laboratory

If for any reason fuel-oil receipts drop in favour of other forms of thermal energy, the deficit must be spread throughout the oil industry as a whole Since petrol is the most thriving product of all for which that industry is responsible, it must perforce shoulder its share—a lion's share at that—of the burden This means that the net profits on the sale of petrol tend to be lessened periodically by a fluctuating amount Since the oil companies with all their faults are at least financially sane, and realise better than anyone else what is the economic minimum at which petrol may be retailed to show a working profit *on the total cost of their complete operations*, not being philanthropists, they have perforce to pass on such fluctuations, either plus or minus, to the consumer, the latter is, after all, the only possible individual who can harmonise the contending factors But this is only one other aspect of the matter

Whatever may or may not be the wisdom of amalgamations or 'combines' as they have come to be known, monopoly, if this be implied and providing it be not abused, can operate in favour of the public by supplying standard commodities at standard or at least economic prices Any undercutting of such prices as may ensue, unless backed by resources constituting a serious menace to the major interests, will be local and short lived The public gains a penny here and there, but is soon forced back to acceptance of 'combine' prices, either through restricted operations of the external interests involved, or through ultimate failure of the latter to contest the market Should there be, however, a definite attempt at breaking monopoly by prolonged attack, supported by the formidable weapons of large resources of equally high quality products, then competition runs keenly and the public is undoubtedly the gainer during the phase of severe price-cutting which ensues

If during this period natural resources were for any reason to decline, a truce might automatically be called, but if, as is the actual case, resources increase at a rate which definitely establishes supply in excess of demand, then sooner or later the position has to be faced by the contending parties which, put briefly, means compromise or bankruptcy There must always be an economic limit, especially in petroleum undertakings, below which it pays no one to produce and distribute petrol, or any other commodity for that matter In the present circumstances, both competition, heavily backed by adequate resources, and over production have helped to bring about the logical situation now being faced by producer and consumer

The recent increase in price of petrol in Great Britain is not an impetuous act of economic or political spite Its incidence is a direct outcome of a chain of circumstances the operation of which has all along been perfectly clear to the intelligent observer who is not content to accept at face value *ex parte* statements in the daily press

The immediate post War price of petrol was, of course, excessive, but rendered inevitable by the difficult conditions of restabilisation of international trade, in which petroleum played no unimportant part This price, however, did not last long, for despite an enormously increased demand for petrol since 1920, supplies more than kept pace, due not so much to over production of crude oil, but, as Davenport points out, to the economic operation of 'cracking' in refinery process Thus, applied science has had a direct hand in price control, for perfection of cracking plants has led to considerably enhanced petrol yield per barrel of oil run to the stills, apart from influencing paraffin production, etc Hence the principal organisations responsible for producing and marketing petrol were able to take full advantage of public demand, and to hand on to the consumer a small share—in the shape of decreased price per gallon—of the success they were enjoying

Then came, as it was bound to do, the Russian entry into the market To understand the full significance of this incursion, it should be recognised that, apart from any commercial or political prejudice, petroleum emanating from the Russian fields is, technically speaking, of exceptionally high quality, a fact well known from the earliest days of the oil industry While this statement in no sense implies inferiority of competitive oils or products, the temporary exclusion of this fuel from European markets was something of a calamity Nothing but abundant resources and sound refining values could have re-established so quickly Russian oil in the world's markets, to the

extent of constituting that country the third most important producer last year Whatever may be the ethics of the case, there has been an undoubted demand for Russian oil in Great Britain during the last few years, a demand which, in its growth, has forced the very issue to which we have referred A measure of the economic situation created in 1928 is to be found in the price of petrol in London prior to Government tax 1s 0½d per gallon (ex pump) Anyone, even with the slightest knowledge of the technical side of the oil industry, knows that such a price is unsound and can never bear a proper ratio to capital outlay and cost of production, especially when it is remembered that from that figure transport charges and retailer's commission must be deducted before the producer can reckon his profit Consequently, things were destined to alter in any case, and compromise between conflicting interests was an inevitable policy foreseen long before the *fait accompli* was realised The natural corollary to such compromise is the raising of the price of petrol to an acceptable economic minimum

In the meantime, however, the Government made an imposition of 4*d* tax per gallon of petrol last year, to which the retailer added ½*d* as cost of collection Thus in London the price of petrol rose to 1*s* 4¾*d* ex pump, or 1*s* 5¾*d* (or more) in the provinces This, however, had nothing to do with the economic situation in the industry, though it may since have had some slight repercussion in the matter of decreased demand The price of petrol at the round figure of 1*s* 5*d* or 1*s* 6*d*, though possibly distasteful to the consumer, clearly left the main problem of economic minimum unaffected, and something was bound to happen to alter these conditions from the point of view of the well being of the industry as a whole The plain fact is that, until the recent increment of 2½*d* per gallon was made by the industry on Mar 1, nothing had occurred to alleviate the serious position of a year ago, the addition of this increment is an expression of compromise between contending interests, or, in the absence of any specific agreement at the moment, it is a measure of consolidation of the inevitable position which the industry must take up to 'put its own house in order' whatever may fall in the future Even now, it should be noted, the increase only brings the total price of petrol to 1*s* 2¾*d* per gallon excluding tax it remains to be seen for how long that price will be considered adequate to the needs of a complex industry

Petroleum, once exploited, is a wasting asset In the face of production on a scale never before achieved or even contemplated, it is difficult to forecast events, but anything which tends to promote its economic production and utilisation may be construed as a measure of conservation, and this care it is the duty of the industry to foster If enhanced price of petrol is economically justified, as we believe it to be, then it will have the effect of strengthening the industry in a determination to prevent waste of this valuable commodity at all costs To this extent recent events have perhaps been beneficial H B M

Practical Oceanography

Science of the Sea an Elementary Handbook of Practical Oceanography for Travellers, Sailors, and Yachtsmen Prepared by The Challenger Society for the Promotion of the Study of Oceanography Originally edited by Dr G Herbert Fowler Second edition, edited by Dr E J Allen Pp xxiii + 502 (Oxford Clarendon Press, London Oxford University Press, 1928) 15*s* net

THE Challenger Society has done well in issuing a new and revised edition of this well known and useful book, which has been out of-print for some years, and the new editor, Dr E J Allen, is to be congratulated on having retained the original character of the work, while bringing it abreast of modern progress Oceanography has advanced in several directions since the War, and its progress has been due in no small measure to British work, though we have had no great oceanographical expedition devoted purely to such problems, as the Germans have had in the *Meteor* expedition One would like to see Britain again taking the lead in great oceanographical explorations, as befits her position as the greatest seafaring nation Much of interest will no doubt come of the *Discovery* expedition, but this is necessarily tied down somewhat strictly to the investigation of the very pressing economic problems arising out of the exploitation of whaling May the "Science of the Sea" help in stimulating that interest in the problems of the ocean which is dormant in the heart of every Briton, and bring the time nearer when the purse strings will be loosened to enable Britain take her rightful part in oceanographical exploration

The book is addressed primarily to "travellers, sailors, and yachtsmen," to all those whom business or pleasure takes upon the great oceans, and it will prove of inestimable service to all such who wish

to take part, in however modest a fashion, in the study of marine problems To those who ask, "What can I do for oceanography?" this book supplies a sufficient and thoroughly practical answer It will be of interest also to others, to those who have no opportunity to do work at sea, but wish to learn about oceanographical problems and the methods by which they are studied Also, the student who is beginning to take up marine or fishery work will profit greatly by a careful reading of this book, which has the great advantage of being written throughout by practical workers of long experience and proved competence

As we have said, the volume follows fairly closely the arrangement adopted in the original edition, and certain sections show little change, though all have been revised The chapters on the air and water have been completely re written, the former by Capt Brunt and Comdr Garbett, the superintendents respectively of the Army and Navy Meteorological Services of the Air Ministry, the latter by Mr D J Matthews and Dr W R G Atkins Both chapters are extremely well done Dr Atkins's contribution deals with the alkalinity of sea water, and gives a full account—perhaps just a little difficult for the beginner—of the methods to be employed in determining the pH of sea water Mr Matthews describes in outline the main current systems of the oceans, and gives eminently practical instructions for the use of hydrographical instruments and methods It might have been well to mention Lumby's surface sampler which makes the collection of water samples from vessels under way much easier and more satisfactory than the old bucket method The definitive description of this instrument has, however, only just recently been published (*Jour du Conseil*, **3**, 3, 1928) An interesting comment is made by Matthews on the echo sounding method of determining depths He rightly fears that the spread of this most valuable method will result in a serious decrease in the number of bottom temperatures and samples of bottom deposits col lected

In the biological sections there is apparent a certain inequality of treatment—the fixed plants, for example, are dealt with in a very adequate manner by Mrs Weber van Bosse, while the fishes receive much less space But one must admit that to treat of the fishes in a comprehensive way would have taken up practically the whole volume The section on phytoplankton, by Dr Marie Lebour, is new, and, though short, is admirably done Prof Stanley Gardiner has re written his fascinating and practical account of tropical shore-collecting, and the section on fishing gear has been considerably strengthened Of great practical value is the chapter on the preservation of marine animals, by Dr Allen and Mr E T Browne—a subject on which expert advice is always welcome Prof D'Arcy Thompson's charmingly written account of whales and seals—and sea serpents—will be of especial value to the ocean traveller

The illustrations are on the whole good, with the exception of some of the small figures of plankton and benthonic animals The useful appendices of the original edition are retained and expanded—a list of marine stations, of literature, of recom mended firms for the supply of apparatus, and an outline biological classification The list of litera ture might have been extended with advantage One notes with interest and some surprise that the number of marine stations listed, in all parts of the world, amounts to more than one hundred The frontispiece is, most appropriately, a portrait of the late Sir John Murray, to whom the science of the sea owes so much

Colliery Economics

The Economics of Coal Mining By Prof Robert W Dron Pp vii + 168 (London Edward Arnold and Co, 1928) 10*s* 6*d* net

THE subject of the above work is one of the greatest possible importance at the present moment when coal mining problems bulk so largely in the public interest Prof Dron has produced a very readable and very useful little book in which most of the problems connected with the economics of coal mining are succinctly reviewed It comprises ten chapters namely, an introductory chapter, one devoted to mineral leases, two to valuations, the first of these referring to the valuation of a mineral property and the second to the valuation of an operating colliery, another chapter considers the economics of the development of a new undertaking another gives estimates of capital expenditure, another the cost of power production, whilst the final chapters are devoted to the organisation of a colliery, to coal cleaning, and to legal considerations, the latter being devoted mainly to the questions of subsidence and trespass

As might be expected from a colliery engineer of Prof Dron's knowledge and experience, the work is throughout of a high order, since, however, a large number of the questions treated of are of a distinctly controversial nature, few mining engineers

will be found to agree with all Prof Dron's views, though a large majority of them will agree with the greater portion thereof

When critically examined, the chapters on valuation are probably the weakest in the book, and give evidence of less clear thinking on this important subject than might perhaps have been expected from the author Thus, in the chapter dealing with the valuation of mineral properties, the author introduces a consideration of the costs of mining operations, such costs have, however, nothing at all to do with the case, because the value of a mineral property is determined solely by the consideration of the income which this property would yield and, therefore, the capitalised value of the mineral royalties In a previous chapter the author has considered the true meaning of royalty and quite correctly distinguishes between it and an occupation rent, and quotes the authoritative statement on the subject from the Report of the Royal Commission on the Coal Industry (1925), which shows that "a rent is paid for the use of a thing which endures," whilst "a mineral royalty is paid for the purchase of the thing itself"

Prof Dron is, however, in error when he considers that the word royalty is a survival from Queen Elizabeth's time The word was never used in this modern sense by medieval writers, and, in fact, its first use in this particular sense appears to date from the first half of the nineteenth century Prof Dron refers correctly enough to the decision about the year 1568, which assigned all mines except royal mines to the owners of the land in which they occur, but he omits to point out that the Crown never at any time even claimed the ownership of or a royalty in respect of coal The distinction is sufficiently important for Prof Dron to have directed attention to it It may also be suggested that the Scotch term 'lordship,' which is the Scotch equivalent of royalty, should not be used without defining it for English readers

Prof Dron has fallen into a curious arithmetical blunder in his footnote to p 31 in discussing the local rates payable by mineral owners in Scotland He states quite correctly that in Scotland the local rates on a colliery are payable approximately one half by the owner and one-half by the lessee, but goes on to say that in England and Wales, "so far as the writer is aware, no part of the local rates is paid by the mineral owner" Prof Dron's statement on the latter point should have been much more definite, and he appears to be unaware of the reason for this difference, in England and Wales the fixing of rates is based upon the well-known statute of Queen Elizabeth's time, which enacts that rates may be levied upon every occupier of coal mines, etc this statute has since been greatly extended and modified and other rates have been added, but the basal principle that the occupier is liable for the rates has never been altered

In Scotland, on the other hand, the fundamental legislation which controls rating is contained in an Act of Queen Victoria's time passed in 1854, and although the general principle laid down in that Act is varied to some extent by the local Acts, its general effect remains, so that approximately one half of the rates is paid by the owners of the mine and the other half by the occupiers The reason for the difference in treatment of mine owners in Scotland and England is thus quite clear

Prof Dron's error, which has been referred to above, is in his calculation of the amount of the local rates payable by mineral owners, which he states "is equal to about 1*s* 6*d* per ton of output" He bases this on his statement that the local rates payable by mineral owners in 1925 were about £230,000 per annum He has previously given the output for that year as 28,394,000 tons (a clerical error in the table on pp 10 and 11 would make this about 28,000 million tons, but this error does not affect the case) A simple calculation will show that the rate above given amounts not to 1*s* 6*d* per ton but to nearly 2*d* per ton, and it can only be surmised that Prof Dron has carelessly misplaced a decimal point Such an error is a comparatively venial one, but in the present instance would lead to important results Prof Dron has no doubt a long and varied experience in dealing with Scottish mineral owners, but it may gravely be doubted whether he has come across one so constituted as to be willing to accept 6*d* per ton in payment for his coal and pay out in return 1*s* 6*d* per ton for his rates Scotch mineral owners are not usually credited with such a degree of quixotic altruism or such utter carelessness to their own interests as a bargain on Prof Dron's lines would appear to indicate, and it is incomprehensible why this fact should not have struck him whilst he was writing the lines in question

It may also be asked what Prof Dron means by stating that his chapter on the valuation of minerals is devoted to the simplest case, namely, "the valuation of minerals in actual course of working," and a few lines further down to discuss such a valuation in the case "if the winding pits are not established on the property under investigation" It

would be interesting to know how the mine could be in the course of working before the winding pits are sunk

In his next chapter, on the valuation of a going colliery, Prof Dron commits an error into which very many, perhaps the majority, of mining engineers are apt to fall He tabulates for a valuation of a colliery the estimated future output and the life of the coalfield, in other words, he commences by stating what the quantity of coal is which the field in question contains This is a fact that neither he nor anyone else can know in advance, he might be entitled to state that the field is estimated to contain a certain quantity of coal, though the more correct statement would be that the most probable quantity of coal contained in the field is so much, the most probable quantity being that which is as likely to be exceeded as to be fallen short of when the coal comes to be actually worked Until it is worked, no one can say how much the field actually contains

Prof Dron deals very briefly with the problem of deferred royalties, and it seems evident that he has not seen the elaborate discussion of the subject in a paper on The Value of a Deferred Annuity, with Special Reference to the Valuation of a Mineral Property, by Charlton Carpmael (*Jour Inst Actuaries*, vol 56, pp 25 72 1925)

In conclusion, it may be said that the chapters here selected for detailed criticism are on a subject which is perhaps the most difficult and the most controversial of any in the book, and the fact that different views are here put forward on many points to those advanced by the author must not be taken as any indication that the book is not an exceedingly valuable one indeed, it is likely to be of the utmost use to all colliery engineers

British Sea Anemones

The British Sea Anemones By Dr T A Stephenson Vol 1 (Ray Society Volume No 113) Pp xiv + 148 + 14 plates (London Dulau and Co, Ltd, 1928)

WHILST in some branches of science, especially physics, there are so many workers in the field that monographs can be continually revised, in others many years must pass by before an expert can bring our knowledge up to date Dr T A Stephenson, one of the two leading workers on anemones at the present time, is to be congratulated on his effort to bring together and set in order the facts known about British sea anemones, their structure, development, bionomics, and classification It is the first successful attempt to supplement the famous work of Gosse completed so long ago as 1860, when the comparative anatomy of anemones had not been studied

It will perhaps be a disappointment to some who have looked forward to the appearance of this important work that the body of it is apparently being held back for a subsequent volume Although the author lays stress on the fact that for the purposes of the monograph a clear understanding of anatomy is necessary, it is doubtful whether the general reader will feel urged to read through the technical and well illustrated section on structure, which occupies the greater part of the text, until the appearance of the next volume this will presumably contain descriptions of the species But the remaining sections, particularly that on bionomics, are full of absorbing interest

The author describes the different haunts of these animals, and points out where the best collecting grounds are, and which species can best be maintained in aquaria Interesting notes are given of the rapid way in which some anemones can move about, of how they capture and digest their food, and, above all, of the various methods of reproduction, even at the mature age of three score years and ten He instances one anemone which, as soon as it begins to rove about, leaves behind pieces of its base, which, retaining hold of the substratum, regenerate into normal individuals True budding is not a characteristic of these animals, the total absence of colonialism and skeleton building being correlated with a relatively active habit Their ancestors were probably creeping, bilaterally symmetrical forms, and radial symmetry supervened when a more sedentary life was adopted

Dr Stephenson is an artist of no mean order, and has drawn a number of beautiful and convincing studies of living anemones He is careful to explain, however, that individuals can look quite unlike the portraits given of their particular species, and that his illustrations necessarily represent fleeting aspects of selected colour varieties of most changeable organisms He goes into the questions of coloration and pattern, and the methods of collecting and maintaining anemones in aquaria Notes are given on natural enemies and messmates The author mentions their use for fishermen s bait, and that they form a considerable part of the diet of some fish like cod, whiting, haddock, and especially flounders A long list of works on anemones is given, and the reader is shown where to look for information under various sub-headings

A K Totton.

Our Bookshelf

The Yearbook of the Universities of the Empire, 1929 Edited by T S Sterling Published for the Universities Bureau of the British Empire Pp xiv + 852 (London G Bell and Sons, Ltd, 1929) 7*s* 6*d* net

IN pre War days, "Minerva" was the standard reference book of the personnel of the universities and learned bodies of the world After a lean period, it has regained its position, but at the cost of growth to three very bulky volumes The "Universities Yearbook" covers the universities of the British Empire and is a compact handbook of less than a thousand pages, its data, being compiled from university calendars and similar official publications, is thus trustworthy

The "Yearbook" is divided into sections dealing with Great Britain and Ireland, Canada, Australia, South Africa, and India respectively Each section is preceded by a brief account of the history and the regulations of the universities of the section, after which each university is dealt with separately A directory of the staff, arranged under departments, is given, followed by general information, including equipment of laboratories, museums, etc, degrees, residential accommodation, changes of staff during the past year, student statistics, and so on

The appendices occupy about a third of the book and provide most valuable information, which is only available elsewhere in widely scattered publications They cover the regulations for professional bodies, matriculation examinations, inter university scholarships and grants for research, professional schools of the universities, and the distribution of subjects in which various universities specialise, centres of research outside the universities, and titles of theses accepted for research doctorates There are name and general indexes

We commend the book to all who wish for information on educational facilities of university standing For ourselves, there are few reference books to which we turn more frequently or with more confidence

The Symmetrical Optical System By Dr G C Steward (Cambridge Tracts in Mathematics and Mathematical Physics, No 25) Pp viii + 102 (Cambridge At the University Press, 1928) 7*s* 6*d* net

THIS is the latest addition to the useful series of Cambridge Tracts in Mathematics and Mathematical Physics It enlarges upon the short section devoted to the characteristic function in the earlier book of the same series ("The Elementary Theory of the Symmetrical Optical Instrument," by J G Leatham), by an early use of the functions of Hamilton and Bruns The author has made a welcome departure from the purely geometrical discussion in calculating the distribution of energy in diffraction patterns associated with the primary aberrations, a purpose for which treatments based upon the principle of optical path are naturally convenient It is to be hoped that the end of optics completely divorced from practice has at last arrived Had the developments made by the author and Mr T Smith been only a little earlier, the subject of geometrical optics might still have been included in the Tripos

It might be suggested that the heading of Chapter v, "The Computation of Optical Systems," is a little misleading The chapter deals with the computation of aberration of optical systems, and not with the design of systems, as the heading might lead one to suspect

The book is, of course, addressed only to readers with the requisite mathematical equipment Those without such an equipment can obtain many of the same results by other means

The Story of the American Indian By Prof Paul Radin Pp xiv + 371 + 30 plates (London John Murray, n d) 21*s* net

IN the story of the American Indian, Dr Radin traces the spread of offshoots of the elaborate Maya civilisation over a great part of North America There was, according to him, one stream of an early stage of Mayan culture that evidently went by sea to the mouth of the Mississippi, spread mainly northwards to found the culture of the Mound-builders, and underwent transformation as it proceeded, eventually these immigrants were overwhelmed by the simpler peoples around them Certain cultural traits spread over the plains, weakening as they reached the north eastern woodlands Another stream (of Toltec culture) flowed into Arizona and New Mexico, where it overlaid an older Mayan layer that had spread from the east, this culture was partially assimilated by the Navaho, Pawnee, and others The capitalists of the north west coast have closer affinities with Asia and striking resemblances to conditions met with in Melanesia The high pre Inca cultures of Peru are discussed in a similar way

Dr Radin traces these connexions in an interesting manner The book should not be overlooked by ethnologists, but being innocent of references and an index, it is apparently written for non specialist readers

Lehrbuch der anorganischen Chemie Von Karl A Hofmann Sechste Auflage Pp xv + 784 + 7 Tafeln (Braunschweig Friedr Vieweg und Sohn A G, 1928) 20 gold marks

THE sixth edition of Prof Hofmann's "Lehrbuch" follows the preceding edition after an interval of three and a half years No drastic alterations have been made, but an important chapter of twenty three pages has been added on the organo metallic compounds This is included in a part of the volume which contains chapters on explosives, structure of inorganic compounds, structure of crystals, radioactivity, and atomic structure Those who are not acquainted with the book may therefore be assured that it deals as adequately with general questions as it does with the properties of individual elements and compounds

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications]*

Excitation of Mercury Vapour by the Resonance Line

THE early researches of R W Wood (1912) showed that mercury excited by the light of the line 2537 emitted resonance radiation of the same frequency as the absorbed light

Accompanying this resonance radiation there is radiation of longer wave length, comprised chiefly in two broad maxima, one about λ3300, and the other giving rise to visual green fluorescence These last radiations, which are regarded as of molecular origin, appear at higher vapour densities than are required for the resonance radiation, which has always been regarded as a purely atomic phenomenon

F S Phillips in 1913 showed that the visual luminosity could be caused to move away from the place of origin if the vapour was in rapid motion Photographing the spectrum, he concluded that the ultra violet radiation around λ3300 and the line 2537 could also be detected in the vapour stream away from the place of origin

I have always been puzzled by these phenomena, and the mystery has not seemed at all less since observing (see NATURE, Nov 10, 1928) that the visible radiation could be produced by excitation lower than the resonance line, and that in this case too the secondary source was capable of being blown away from the place of excitation

The question arises What is the relation between the 2537 radiation and the visual radiation in Phillips's experiment ?

Although not yet prepared with a complete answer, I wish to describe some experimental results which analyse the phenomenon more closely than has yet been done

The distillation may be carried out *in vacuo*, or with a moderate air pressure in the condenser, which results in a more dense but less rapid vapour stream The added air does not mix with the mercury vapour under these conditions until the condenser is reached

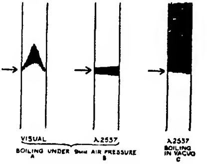

FIG 1

Distilling the vapour up a silica tube 1 5 cm square section, with an air pressure of 9 mm in the condenser, the visual glow is of the shape shown in Fig 1A, the arrow indicating the direction of the narrow incident beam The arched form indicates, as Wood and Pienkowski have shown, that after excitation there is a time lag before the luminosity sets in This is most apparent in the middle of the tube, where the stream is most rapid

On the other hand, the re emitted ultra violet radiation comes laterally from the cone marked out by the incident rays, undeflected by the vapour current (see Fig 1B) This appearance is obtained by photographing through filters of chlorine and bromine in series, which transmit the line 2537 but cut out the less refrangible radiations

Finally, on making the vapour current more rapid by completely exhausting the condenser, the visual radiation is thinned out to vanishing point, and the source of 2537 radiation moves up as well (see Fig 1C) That this really is the radiation 2537 was checked by photographing through chlorine and bromine with addition of mercury vapour in an independent cell, of such thickness and density as to absorb about a breadth of 1 A at this point without absorption at any other relevant part of the spectra The luminosity in the tube was altogether cut out by this filter

It seems therefore, so far as can be judged from the evidence yet available, that the 2537 radiation is simply Wood's resonance radiation, and that in the experiments with a blast of vapour its source can be observed as separated in space from the source of the continuous bands which are doubtless of molecular origin But if this interpretation is accepted, the surprising thing is that the source of resonance radiation is in itself capable of moving considerable distances in a sufficiently rapid blast This would show that the interval between excitation and emission is under some conditions enormously longer than the 10^{-7} seconds usually assigned If so, many received views will need revision

RAYLEIGH

Terling Place, Chelmsford,
Mar 14

The Constitution of Oxygen

W F GIAUQUE and H L Johnston in a recent letter (NATURE, Mar 2, p 318) state that certain observations on absorption bands are only explicable by the hypothesis that oxygen contains atoms of mass 18 Unfortunately, they do not give any indication at all of the abundance of these relative to the normal atoms

So far as I am aware, there is no evidence obtained from positive ray analysis of any kind which would lead us to suppose oxygen other than a simple element In my recent measurement of packing fractions the line due to O^{16} was taken as standard and, to take the cases in which the evidence is most trustworthy, the atomic weights of hydrogen, fluorine, and iodine determined in this way were found to agree with the accepted values to within one part in ten thousand The latter are expressed in terms of the mean atomic weight of oxygen, so that this is very strong, though indirect, proof that if O^{18} exists it cannot be present even to the extent of one part in one thousand

In order to obtain evidence of a more direct kind I have done two experiments, one with the O_2 line, the other with the H_2O line In the first the discharge tube was run with oxygen giving a strong line O_2 at 32 Now if O^{18} exists, there would be a line due to the molecule $O^{16}O^{18}$ at 34 of a strength directly proportional to the quantity of O^{18} present With half an hour exposure a barely visible effect at 34 was obtained Its relative intensity was measured by photometry against other and very short exposures of line 32 and came out at 0 14 per cent This very faint effect may, in my opinion, be due to traces of S^{34}

In the second experiment water vapour was

employed, and the faint line at 20 compared with the strong one at 18 in the same way. Here the effect was rather greater, amounting to 0.32 per cent. In an apparatus to which air has to be frequently admitted, one would expect some effect due to A^{40++} and Ne^{20}, but I think in this case it is to be ascribed mainly to $Si^{28}C^{++}$. In any event, the presence of the line may be explained without recourse to an unknown body.

If it can be shown that the absorption band effects are compatible quantitatively with the presence of the hypothetical isotope in proportion less than one part in 500, the matter will require further investigation. Otherwise it seems more reasonable to seek for them an alternative explanation and continue for the present to regard oxygen as a simple element.

F. W. ASTON.

Cavendish Laboratory,
Cambridge, Mar. 15.

Tsetse Fly and Big Game

REFERRING to an editorial entitled "A Threat to the Zululand Game Reserves" in NATURE of Nov. 24, 1928, whilst very much in sympathy with the object of this article in so far as it refers to preservation in reserves of the natural fauna of South Africa, I am led to express the opinion that certain of the statements made would be very difficult to substantiate on the basis of available scientific data.

The article gives the impression of having been written rather from a partisan point of view than from that of a detached scientific reviewer. The relation between certain species of tsetse fly and game is certainly a controversial subject, but it is considerably less so amongst those best acquainted with the tsetse fly problem than some ardent advocates of indiscriminate game preservation would have the world believe. In any case one does not expect NATURE to ignore the views of the leading entomological investigators on such a question. I may also point out that the *Journal of the Society for the Preservation of the Fauna of the Empire* is scarcely the publication in which one would expect to find unbiased views on this subject.

Justification for my venturing to offer criticism is to be found in the fact that a misstatement is included concerning certain experiments stated to have been carried out in this Colony, and further in the fact that vigorous efforts are being made by my Government at the present time to arrest the spread of tsetse fly in certain areas through reduction and control of game.

The misstatement referred to is contained in the passage, "On the other hand, satisfactory and unobjectionable methods of extirpating the tsetse fly and reducing the incidence of nagana in domestic stock are known, as has been shown by experiments carried out in Southern Rhodesia, where the bush itself, the winter retreat of the tsetse fly, has been attacked." It is true that many years ago, impressed by the apparent segregation of *Glossina morsitans* in shady forest during the latter part of the dry season, I suggested that in some localities destruction of these haunts might prove a practical method of eliminating the fly. It is also true that some experiments along these lines have been attempted in the Colony. It is not, however, true that these experiments have revealed a "satisfactory and unobjectionable" method of extirpating tsetse fly. In the first place, they have never been pursued to a satisfactory conclusion, and in the second, it is more than doubtful if they can be described as "unobjectionable" either from the sentimental or practical point of view. Surely to the Nature lover large scale destruction of many of the most conspicuous and beautiful representatives of the natural flora must be equally objectionable as destruction of the fauna. The game in any case is capable of more rapid recovery than the forest, providing, of course, that in neither case is reduction pursued to extermination. From the practical point of view there is, of course, no question concerning the objection to the destruction of useful timber.

Careful perusal of the article reveals the fact that the ultimate dependence on the game of such species of tsetse fly as *Glossina morsitans* and *G. pallidipes* is not actually called in question. I take it, therefore, that the main contention is that it is not possible or not practicable to reduce the game sufficiently to make conditions unsuited to the fly, and that attempts to do so may have untoward consequences.

With reference to the possibility of game extermination aggravating the trouble in respect to domestic animals, I may state that the experience in this Colony is that any developments of this nature following persecution of the game have been very limited and of a purely temporary nature. So far, the final event has been a marked improvement on the original position.

It is noted that no reference is made to the possibility of tsetse fly being scattered by other methods involving interference with conditions in a fly belt. Wholesale destruction of the forest in a fly belt in the Hartley district of this Colony in 1913 was certainly followed by the temporary appearance of trypanosomiasis farther afield than it had occurred for years, although the number of flies present was exceedingly small. Had this belt been heavily infested, it is at least possible that much more serious losses might have been sustained. The final event in this case was, however, also satisfactory.

With regard to the next sentence, justification appears to be lacking for the statement that "total extermination of all wild carriers of nagana which the policy demands if it is to be effective." On the contrary, experience in South Africa indicates that total extermination of game is by no means necessary to get rid of certain species of tsetse fly and the diseases they convey. The bibliography in Austen's "Monograph of the Tsetse Flies" contains notes of interest in this connexion. The late Mr. Claude Fuller has also collected a number of valuable records in the Transvaal. Dr. Schwetz has recently pointed out how tsetse fly has receded with the game around Elizabethville in the Katanga. There is a considerable amount of additional evidence in this Colony.

"It is believed that the segregation of game in reserves tends to keep the tsetse fly restricted to definite areas." Segregation of game presumably implies a game reserve surrounded by game free country. Certainly, maintenance of a game reserve will not restrict the range of tsetse fly, if conditions are suited to its perpetuation outside the reserve. The inhibiting factor would, therefore, be found in surrounding conditions not the reserve itself. The suggestion that it is possible to reduce the game sufficiently around a reserve to produce conditions unsuited to the fly appears scarcely in accord with what is apparently the main contention of the article.

The statement that "slaughter of big game ... has not succeeded, and cannot succeed, in reducing the numbers of tsetse" is an assertion which ignores the whole record of tsetse fly in South Africa and the published work of investigators fully qualified to formulate an opinion on this subject. A good case can certainly be made out for the view that slaughter of big game has in the past succeeded very markedly not only in reducing the numbers of tsetse (*G. morsitans*

and *G pallidipes*) but in eliminating these insects from considerable areas It is also not difficult to offer a plausible explanation of how this slaughter, falling short of extermination, would tend to eradicate these flies Whilst the case may not be considered absolutely proved, there is no justification whatsoever for unconditional denial of the possibility of controlling tsetse fly through the game, particularly in limited areas

I have no intention of entering into the controversy as to whether the Zululand game reserve should be abolished or otherwise My object is purely to deprecate the appearance in a leading article in NATURE of unqualified statements which are open to challenge, and the treatment of a scientific and economic problem from a less dispassionate point of view than readers of NATURE have learnt to expect

RUPERT W JACK
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Feb 4

READERS of NATURE are familiar with the controversy which has raged round the question of coincident game and tsetse extermination, and the article referred to was obviously not a full summary of the divergent views, as was implied in the words "many competent observers hold," etc It was meant to point to considerations which seemed to have been overlooked in the case of the Zululand Reserves In view of the crude method of game extermination which has been widely advocated, it is regrettable that the experimental destruction of the segregation haunts of tsetse, which seems to have been based upon sound entomological observation, was not pursued to finality, as we had understood, especially as Mr Jack admits that the less scientific wholesale destruction of a forest fly belt had satisfactory results The fact that some years ago "an ill advised game drive [in the Zululand region to which the original article referred], by scattering animals over farms in the neighbourhood, undoubtedly led to the infection of the cattle of colonists by nagana and it is alleged that about 1000 head died," strongly suggests that segregation in the reserve area limited the incidence of the disease Finally, Mr Jack's own report of 1926 on the "Tsetse Fly in the Lomagundi District" largely quoted by the *Journal of the Society for the Preservation of the Fauna of the Empire* (1926), the impartiality of which he impugns, indicated, by its comparison between the anti nagana results of present day settlement and the pioneer settlements in South Africa, that the rapid retiral of big game in fact its local extermination, and nothing short of that, was the predominant cause of the disappearance of tsetse

THE WRITER OF THE ARTICLE

Knock Ratings of Pure Hydrocarbons

IN their letter on page 276 of NATURE of Feb 23, Prof Nash and Mr Howes point out the value of unsaturated hydrocarbons in suppressing knocking Their figures show that benzene and toluene, which for some time were considered the most effective anti knock hydrocarbons, actually possess this property to a very much smaller extent than many unsaturated hydrocarbons, particularly in the aliphatic series The statement that pseudocumene has pro knock tendencies is, however, misleading, particularly as Edgar's octane (1 1 3 trimethylpentane) is referred to in the same paragraph as a valuable anti knock Pseudocumene may be pro knock when compared with benzene, but it is certainly not pro knock in the general meaning of the term Compared with benzole in high concentrations, Edgar's octane is also pro knock The terms pro knock and anti knock are used rather loosely, and it must be remembered that they only have a definite meaning when a standard fuel is mentioned

Although our own results for the hydrocarbons tested by Prof Nash and Mr Howes fall in approximately the same order, there is one very noticeable exception We find that diamylene is not such a good anti knock hydrocarbon as they indicate, and that it certainly is not better than the parent hydrocarbon, trimethyl ethylene, from which it is derived If this were true, as Prof Nash and Mr Howes' figures indicate, it would then be desirable to polymerise the lower unsaturated hydrocarbons as Reiman does in the patent quoted, which would be contrary to all refining experience, in which it has always been found that the treatment of any unsaturated product involving polymerisation always reduces the anti knock properties Our own figures for diamylene prepared from trimethylethylene by polymerisation with sulphuric acid, and also for diamylene obtained by fractionating the high boiling hydrocarbons formed when commercial amyl alcohol is treated with zinc chloride are much lower than those obtained for trimethylethylene in equivalent concentration Furthermore, the fractions from the latter source boiling over the range containing the triamylenes after suitable purification, give even lower figures than those obtained for diamylene This result was only to be expected

AUDIBILITY TEST ON RICARDO E 5 ENGINE

	H U C R	Change in H U C R	n Heptane Benzene Equivalent (By Volume)	
			Per cent	
Standard reference fuel	6 3		44 7	55 3
Trimethylethylene	7 2	+0 9	29 7	70 3
Diamylene from trimethylethylene	6 96	+0 66	32 3	67 7
Diamylene from coml amyl alcohol	6 90	+0 60	33 2	66 8
Triamylene b p 240°–250° C	6 56	+0 26	39 0	61 0

The substances were tested in 20 per cent (by weight) concentration in standard fuel Every substance was tested over as wide a range of concentration as possible partly to reduce experimental error, and also because the relation between concentration and anti knock value is not necessarily linear When comparing polymerides, it is of course essential to work in weight concentration, as polymerisation does not involve a change in weight but generally one of volume

Results confirming the observation that polymerisation reduces the anti knock value were also obtained for methyl*cyclo*hexene and its dimeride methyl*cyclo*hexyl methyl*cyclo*hexene

AUDIBILITY TESTS ON RICARDO E 5 ENGINE

	H U C R	Change in H U C R	n Heptane Benzene Equivalent (By Volume)	
			Per cent	
Standard reference fuel	6 3		44 7	55 3
Methyl*cyclo*hexene	7 02	+0 72	31 7	68 3
Methyl*cyclo*hexyl methyl*cyclo*hexene	6 50	+0 20	40 1	59 9

The substances were tested in 20 per cent concentration (by weight) in standard fuel

While testing *cyclo*hexene a very interesting observation was made It was found that the value in any definite concentration was determined by the history of the sample For example, a sample which had been standing in the laboratory improved in anti knock value when distilled over sodium On exposure to light and air this value fell rapidly, another sample, stored in a brown bottle, did not deteriorate nearly so rapidly Eventually this behaviour was traced to the presence of traces of *cyclo*hexene peroxide, which is readily formed under the conditions described (compare *J A C S*, 50, 568, 1928) This peroxide appears to be quite stable in solution and to accumulate on storage The following are the figures obtained

AUDIBILITY AND BOUNCING PIN TESTS ON ARMSTRONG ENGINE

		H U C R	Change in H U C R	n Heptane Benzene Equivalent (By Volume)	
				Per cent	
Standard reference fuel		5 6		44 7	55 3
*Cyclo*hexene					
Refluxed 48 hours over sodium Maximum value	20% solution by weight.	6 25	+0 65	34 9	65 1
Exposed to light and air six months	20% solution by weight.	5 46	−0 14	47 3	52 7
Stored in brown bottle in diffused light six months	20% solution by weight.	6 07	+0 47	36 8	63 2

Not all unsaturated hydrocarbons, however, appear to form peroxides so readily, often, if they do, decomposition occurs with the deposition of gum The sample of *cyclo*hexene left in the light for six months deposited no visible gum

The importance of testing unsaturated hydrocarbons to make sure that no peroxides are present must be emphasised, as the values obtained may be erroneous if this precaution is not adopted Rough analyses of the samples of *cyclo*hexene referred to above gave 0 2 gm peroxide oxygen per litre for the sample left in the light, and 0 009 gm per litre for the other sample It is interesting to note that *cyclo*hexene in contact with air shows indications of the presence of peroxides after a short exposure to ultra violet light

The observations of Prof Nash and Mr Howes that the olefines, which are comparatively stable towards certain oxidising agents, are the most effective in suppressing knocking, agrees well with our own In general, we have found that comparing isomerides, the more compact a hydrocarbon molecule is the greater is its tendency to suppress knocking Thus trimethylethylene is better than pentene—2 This conclusion is in agreement with Dr Edgar's observation with regard to the isomeric heptanes

The effect of introducing a second double bond is interesting Of the hydrocarbons examined, those containing conjugated double bonds (*e g* $\beta\gamma$ dimethylbutadiene, $\Delta^{1\,3}$ *cyclo*hexadiene and butadiene) have excellent anti knock properties. A diolefine in which the double bonds are not conjugated (*e g* diallyl) does not possess particularly marked anti knock properties In this connexion the effect of introducing double bonds into a *cyclo*hexane ring is interesting

The substances were tested in 20 per cent concentration by weight

The difficulty of correlating engine tests with conventional formulæ at once becomes apparent

Another point of interest is the effect of the side chain attached to a benzene ring Although it is now well known that an increase in the length of the chain

AUDIBILITY TEST ON RICARDO E 5 ENGINE

	H U C R	Change in H U C R	n Heptane Benzene Equivalent (By Volume)	
			Per cent	
Standard reference fuel	6 3			
*Cyclo*hexane	6 56	+0 26	39 0	61 0
*Cyclo*hexene	6 76	+0 46	35 4	64 6
$\Delta^{1\,3}$ *cyclo*hexadiene	7 32	+1 02	28 7	71 3
Benzene	6 57	+0 27	38 8	61 2

reduces the anti knocking properties, the opposite effect is found with side chains attached to benzene rings For example, toluene has greater knock suppressing tendencies than benzene, ethylbenzene than toluene, and propylbenzene than ethylbenzene Yet xylene is inferior to ethylbenzene as an anti knock, and pseudocumene is stated to be similarly inferior to benzene Any theory which can explain all these facts must of necessity be very elastic

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Swirl Opalescence

WHEN preparing the lecithin cholesterol suspension required for the reaction of Murata (*Jap Zeit für Derm u Urol*, 22, No 11, 1922, *Sci Reports Japanese Gov Inst Infect Dis*, vol 2, 1923), I noticed that the most effective suspension was one which was free from visible suspended particles when freshly prepared, though the converse—that any truly colloidal suspension was suitable—was not true The author did not note the point among his elaborate directions He directed that the suspension should be used after standing about twenty minutes Since at the end of this time the suspension begins to show a faint nacreous opalescence which is not removed by filtration through ordinary filter paper, it is possible that the reaction depends in some way upon a change of state from the truly colloidal to the condition of a coarse suspension It may be remarked that for the Wassermann antigen containing the same components an approximately colloidal state is not requisite

It is interesting to inquire upon what the property of swirl opalescence depends The phenomenon is well shown by so called gold paints and similar preparations, which are suspensions of small metallic flakes formed by stamping a suitable metal Since these preparations show a high degree of swirl effect, it might be thought that a laminar structure of the suspended solid would be a necessary condition for the manifestation of the phenomenon It is nevertheless difficult to demonstrate the effect well with aqueous suspensions of cholesterol, although the typical crystal of cholesterol is a lamina Blood corpuscles in urine or isotonic saline show swirl opalescence, but to a smaller degree than does a suspension of coliform organisms Suspensions of cocci do not show the phenomenon

Since swirling produces a local orientation of liquid into parallel planes, swirl opalescence may be taken to result from locally regular reflection of light from particles in these planes The particles must be

opaque, and good reflectors, or possess a refractive index differing sufficiently from the refractive index of the medium Moreover, they must have at least one dimension considerable with respect to the other one or two dimensions, in order to provide the turning moment which shall set them finally along the plane of the stream Thus the phenomenon may be shown not only by lamellar structures, but also by bacilli and acicular crystals

Probably the best known example of the phenomenon is afforded by a familiar brand of household ammonia, in which minute crystals of salts of the higher fatty acids are suspended Microscopic examination shows that the crystals are acicular, or plumose Suspensions of benzidine in very dilute alcohol show a high degree of opalescence Commercial solid recrystallised benzidine appears laminar to the naked eye, and if it is dissolved in alcohol and allowed to evaporate, a mass of broad thin plates, often of considerable length, is seen Support is thereby suggested for the presence of laminæ in its opalescent suspension, but further examination did not altogether confirm that theory

A suspension was prepared by rapidly adding 0 5 c c of a hot 2 per cent alcoholic solution of benzidine to about 50 c c of water at room temperature Microscopic examination on a slide without a cover glass, of a drop of the suspension, showed a number of acicular crystals, with a larger proportion of almost circular, very thin, platelets A film formed on the surface, and the film was almost entirely composed of aggregated platelets When the drop was examined in a covered hæmocytometer chamber, acicular crystals preponderated the platelets appeared to be the product of slow evaporation, and were the chief forms in a film which formed on the surface of the bulk of the suspension Two other suspensions were prepared similarly, except that for one the water was warmed to about 30°, and the other was warmed to that temperature after addition of the benzidine solution When these clear solutions had cooled they deposited crystals just visible to the naked eye, and the opalescence differed much in degree and kind from that of the unheated suspensions Microscopic examination showed that the crystals were almost entirely lamellar agglutinations, which, probably owing to their extreme thinness, had far less effect in producing opalescence than had the acicular forms

To the question why a definitely acicular crystal, such as lead iodide, does not give more than an incipient swirl opalescence, the reply may be suggested that it is partly because its high specific gravity favours rapid settling, and partly because the crystals are relatively large, that is, their number in a given volume is not great enough to enable them to reflect light with sufficient regularity The relatively large lamellar particles of gold paints each reflect an appreciable amount of light, making up in surface what they lack in numbers

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Rigidity in Weak Clay Suspensions

IN the course of work necessitating the purification of quantities of the smallest soil particles (the so called clay fraction), a striking phenomenon was observed during the flocculation and sedimentation of the material in dilute hydrochloric acid Many industrial and laboratory processes entail flocculation and sedimentation, so an account of our own observations may be of general interest When the concentration of the suspension exceeds a certain critical value—the significance of which will appear later—a number of sharp ramifying fissures develop containing clear liquid The density of this being less than that of the surrounding clay laden liquid, a circulation is set up, clear liquid rising through the fissures while the remainder sinks Some of the fissures form against the glass walls of the vessel, so the progress of sedimentation can be watched in detail Near the bottom of the vessel the fissures tend to close, and to enlarge progressively towards the top of the column into conical chimneys, through which the motion of the ascending liquid can be traced by the movement of floccules detached from the walls of the fissures The circulation is completed by the deposition of these floccules in a crater or ring around the exit of the chimney There is no doubt that the suspension has acquired rigidity The descending surface retains the initial form impressed on it by the curvature of the meniscus and by occasional air bubbles floating on the water Marks deliberately made on the clay surface with a rod are also retained

Weaker concentrations settle much more rapidly,

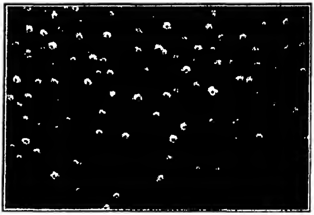

FIG 1

in those less than one quarter of the critical, the floccules fall individually, whereas at half the critical value the floccules settle *en masse*, leaving a clear supernatant liquid In the latter case the suspension subsides with a perfectly flat surface, which, when disturbed, shows no sign of rigidity But as the flocks settle on the bottom of the vessel, a layer is built up which has a concentration great enough to show rigidity The chimneys already described then form, and extend progressively upwards towards the descending surface When this is still about 1 cm above the tops of the chimneys, discrete domes, often exceeding 1 mm in height and 1 cm across, are formed over them, and finally each mound develops a well defined hole at the summit This stage is shown in the accompanying photograph (Fig 1)

It would appear that the clay concentration in the upper layers at the moment of perforation of the mounds is the minimum at which rigidity can occur An independent test of this point was suggested by other work in progress in this department on the plastic properties of soil and clay pastes measurements of the rate of flow through a capillary tube under different stresses have demonstrated that departure from the Poiseuille Law occurs only above a certain critical concentration For our suspensions this value was found to be identical, within the limits

of experimental error, with that in the immediate neighbourhood of the perforated mounds as determined directly on a sample removed with a pipette The agreement is not affected either by removing the coarser clay particles or by the addition of fine silt, but, as would be expected, the critical concentration increases with the coarseness of the suspension It is interesting to note that the critical concentration, even in the coarser suspensions, is only about 1 5 per cent by volume

The above remarks apply to the case in which the minimum amount of electrolyte for flocculation was used ($N/1000$, HCl) Parallel experiments with strengths up to $N/100$ show that the amount of electrolyte present is not without influence on the phenomenon For example, the minimum concentration for rigidity, as determined in the plastometer, is now above that at which mounds develop in sedimentation experiments There is evidence that this is due to thixotropic gel formation, that is broken down in the preliminary shearing given to the clay in the plastometer before measurements are begun This possibility will be followed up during further investigations of the phenomenon now in progress

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Modes of Distribution of the Mudfish in the Philippines

ON Luzon, the main island of the Philippine archipelago, there are only two real seasonal variations, known as the dry and the wet or rainy seasons During the dry season, October to May, there is practically no rain At this time the smaller bodies of water dry out, and lower fields are covered with cracks crevices and clods running in all directions Water remains then only in isolated deeper ditches, swamps, and larger rivers During the rainy season, June to September, everything is flooded Not only the swamps and ditches, but even the rice fields are full of water This is especially true in the eastern part of the island At this time thousands of small fish appear in the rice paddies They are the young of the fish *Ophiocephalus striatus* Bloch, which is known in English as *mudfish* and in Tagalog as *dalag* The young fry is known to Tagalogs either as *bulig* or as *anak nang dalag*, that is, the children of dalag

The Tagalogs have a number of theories concerning the occurrence of this fry in the rice fields Some hold that it originates from the mud, others that it rains down from clouds, still others, claiming some education, think that the old fish aestivates in the mud, and then when the rains come they emerge and lay the eggs Some even think that the eggs are laid in the preceding year, remain dormant during the dry season, and hatch when the rains come The first two notions need not be considered seriously here The third theory, that the fish can survive in dry mud some five or six months, has no proof The dalag, aided by its accessory respiratory apparatus, may live in water which is not fit for any other fish to live, but when it comes to a complete absence of water, the situation is changed It may live for two or three days on a wet market table, but when it jumps out from an aquarium on the laboratory floor in evening, it never survives until the morning During my five years' residence in that part of the Islands I have never been able to learn from the people of a case where a fish could survive in the mud during the dry season, and I have been making constant inquiries, especially from the country people The eggs are also very sensitive to the external surroundings Normally they hatch within two or three days, and do not live through any greater length of time without hatching

There are three possibilities which may account for the occurrence of the young fish in the rice paddies The old dalags may swim from rivers into flooded fields and then lay their eggs There are many well-known instances where freshwater fishes leave the deeper waters for spawning purpose The dalag is not very particular in this respect but some of them do actually migrate from deeper to shallower waters, though they seldom reach the rice fields The young fish if hatched near the rice fields may easily swim into them They are strongly positively rheotropic, and very good swimmers The waters receding from the rice fields give the young fish an opportunity to reach them These two modes of distribution account for a considerable number of cases but the most important mode of distribution is by means of the eggs themselves

The eggs of dalag are 'pelagic' or floating eggs They are quite large (1 25 1 5 mm), have the germinal discs on one pole, and an oil droplet on the other The oil being lighter than water buoys the eggs, so that it floats on the surface in such a way that the germinal disc is always submerged just under the surface of the water where the conditions for its development may be considered the best Such eggs float very easily in any direction, depending upon the wind During the rainy season the typhoons bring very strong winds When the fields are flooded and the boundaries between the larger bodies of water and the rice paddies disappear, the wind carries the eggs there In such a way the eggs may be carried into most unlikely places After a strong typhoon in Manila, 1927, large numbers of eggs were brought to the University of the Philippines Rizal Hall, right to the door of the Zoology Laboratory At a distance of about 300 metres on the opposite side of the campus is located a drainage tube leading indirectly to Pasig River The drainage path itself is more than 300 metres long The campus is dry throughout the year with the exception of a short time during the stronger typhoons when it may be submerged for a few days Much better means of communication are found at such times between the rice fields and the larger bodies of water and I think that this is the most important means for the distribution of dalag in the rice fields

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Major Segrave's Speed Record of 231 m p h

THERE has been much self satisfied amusement over the five places of decimals in which Major Segrave's speed record on Mar 21 was recorded in the Press Truly these are merely arithmetical residues—a waste product A lad with a healthy sense of what is the good part of an apple scoffs at saving up the skin for microscopic study—it is a waste product

Let us take to the microscope—at the cost of knowing a little more and laughing a little less

To the Royal Automobile Club, Sir Charles Wakefield gave not only a £1000 Trophy but also a £1000 a year for the 'world's record' holder until he is beaten If the amount were 6d the moral compulsion to enforce the letter of the law in sporting matters remains, but I quote the amounts to impress the Philistines

Now thirty years' evolution of motor racing has

saddled us with history, precedents and rules In this case the rules call for

(1) A level track of officially certified length properly surveyed—gradient tolerance, etc
(2) Automatic timing to $\frac{1}{100}$ sec
(3) A to and fro run—not only to eliminate gradient effect but also to average the wind effect (otherwise *all* attempts would be made in a following gale of wind)

Following horse racing precedent, the *written record* itself was not a velocity in miles per hour, but a *time* It was the average of the two times actually measured For popular consumption a speed has been worked out from this mean time and this, though it is *not* the speed of the vehicle, is universally taken as such, and it is now treated as the record

(I explain that the true mean speed is the mean of the two speeds, on the runs, and not the result of dividing the length by the mean of the two times) When a record has stood unquestioned beyond the delay for appeal it is established and cannot be altered This protects holders from having to fight for their title up to an indefinite date Looking as we are through a microscope, all this is very wrong scientifically—in practice it is not very significant

Now in doing the prescribed arithmetic there appear these wasted decimals and no provision for ignoring them The first step to a remedy is to pass a new rule that records shall not be deemed beaten unless the new performance exceeds the last by x m p h , and such a resolution has been placed on the agenda of the A I A (The International Association of Automobile Clubs) by the Royal Automobile Club, but I greatly doubt if it will be carried—for two reasons

(1) Rigidly speaking, a bit of true speed should not be added to a numeral which is not a speed
(2) In fairness to the next competitor, the existing record holder should not be protected in his tenure of the spoils (the £1000 a year) with an excess—which he himself was not subjected to, since this partakes of altering the rules of a contest while it is in being

Those who say that I am caring *de minimis*, do not realise how jealously these preferences, however small, are regarded Reason (2) will not, I surmise, be raised, but it may well dominate the discussion What will be raised is the objection to breaking the comparative position of the items in the list of records The War has probably played havoc with the archives of the earlier records so that they could not well be written up in terms of the new method of calculation (mean of velocities in lieu of mean of times)

For the ordinary man the speeds are substantially as given for the clever man they are still as given, and in addition they afford him the added pleasure of feeling clever Shall we not continue to spread happiness among the wise ? MERVYN O GORMAN

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Pall Mall, S W 1

Colour and Optical Anisotropy of Organic Compounds

I DESIRE to direct attention to a significant and very generally valid relation which emerges from an examination of the data accumulated by eight years of systematic research at Calcutta on the scattering of light The generalisation may be stated thus *The types of molecular structure in carbon compounds which favour the development of colour are those which exhibit an exceptionally high degree of optical anisotropy*

When we compare a series of compounds in respect of their optical anisotropy, and their colour as indicated by the position of their absorption bands in the spectrum, the parallelism between the development of the two characters becomes evident Thus, the aromatic series of compounds are generally more anisotropic than the aliphatic series We have large increases of anisotropy when we pass from pyridine to quinoline, or from benzene to naphthalene and thence to anthracene The introduction of a chromophore like NO_2 or auxochrome like NH_2 as a substituent in the benzene molecule produces a notable increase in anisotropy Less striking but perfectly definite increases occur when halogens of increasing atomic weight replace the hydrogen atom in the benzene ring In the disubstituted benzene derivatives, the relative position of the groups influences the anisotropy appreciably These and many other instances may be cited to show that an increase in optical anisotropy connotes a development of colour

That variations of structure in carbon compounds should influence the two optical characters of anisotropy and colour in similar ways need not occasion surprise when we recollect that the element carbon in its two states, diamond and graphite, itself exhibits the same tendency Diamond is a transparent and isotropic dielectric, while graphite is opaque conducts electricity, and has a highly anisotropic structure as shown by X ray analysis and by its diamagnetic behaviour C V RAMAN

210 Bowbazar Street,
Calcutta Feb 28

Magnetic Storm of Feb 26 28, 1929

IN the Astronomical Column of NATURE of Mar 9, mention is made of the auroral display of Feb 27 The display, as seen from various places in the British Isles, particularly in north east Scotland has been fairly fully described in the daily press The accompanying magnetic storm was notable on account of the magnitude of the fluctuations of magnetic force A detailed description of the storm would occupy too much space, but information on any particular point could of course be given, on application, to anyone interested

At the Lerwick and Eskdalemuir magnetic observatories, it has been customary for some time to run additional auxiliary sets of magnetographs of lower sensitivity than the standard instruments, so that a reasonably complete record, even of the extreme fluctuations in storms, may be available In the present case Mr Lee of Lerwick Observatory reports that the lower limit of registration, even of the auxiliary Horizontal Force instrument, was exceeded from 28 d 1 h 3 m to 8 m The ranges of variation actually recorded at Lerwick were 3° 57 in Declination, $>1885\gamma$ in Horizontal Force and 940γ in Vertical Force ($1\gamma = 10^{-5}$ C G S units) At Eskdalemuir, as is usually the case in the great storms, the ranges were of roughly half the above order, being in fact 2° 8 8 in Declination, 916γ in Horizontal Force, and about 690γ in Vertical Force

The last occurrence of a storm with variations of magnetic force of the above order was on Oct 13–16, 1926 On that occasion a magnificent auroral corona was seen from many parts of the British Isles and northern Europe The ranges recorded at that time were, at Lerwick, 3° 41 in Declination, $>1068\gamma$ in Horizontal Force and $>2086\gamma$ in Vertical Force , and at Eskdalemuir $>957\gamma$ in the West Component, $>719\gamma$ in the North Component, and $>624\gamma$ in the Vertical Component A H R GOLDIE

Meteorological Office,
Edinburgh, Mar 15

The Bronze Age in Southern Africa

By Prof RAYMOND A DART, University of the Witwatersrand

IN view of the impetus which has been given to the metallurgical analysis of ancient copper and bronze objects by the initial investigations of Prof John Sebelien of Aas, Norway (NATURE, Jan 10, 1924), and the practical activity of the British Association Research Committee which has resulted in the important interim report embodying the recent investigations of Prof C H Desch (NATURE, Dec 8, 1928), it is ardently to be hoped that funds will not be lacking for following up Prof Bernard W Holman s suggestions (NATURE, Dec 29, 1928) concerning the further collection and publication of data about the ancient mining industry and the products thereof which are available in southern Africa

It has been the uniform experience of those who have investigated the ancient mining industry in South Africa that the work has been on so gigantic a scale as to preclude any belief that the products of the industry were consumed by a local population Beginning with the investigations of Mr T G Trevor, at that time Inspector of Mines for the Union Government, and now holding a similar post for the Rhodesian Government, several important papers by Woodburn and Baumann and others have been published in the *Journal* of the Chemical, Metallurgical, and Mining Society of South Africa which established not only the above mentioned conclusion but also the further important deduction that the early copper tin, micaceous iron and ochre getters had the same sort of industrial implements as the ancient gold getters of Rhodesia and the north eastern Transvaal

On similar lines of reasoning it was possible for me (NATURE, June 21, 1924), by gathering together information from these and other sources, as well as by my personal investigations, to put forward the thesis that the enormous ancient mining district from Katanga and Broken Hill to Pretoria, and from the Kalahari to the eastern coast, formed a single cultural unit

In the *South African Geographical Journal* of that year I developed the same view in an article on "The Ancient Mining Industry in South Africa," and in NATURE, Mar 21, 1925, p 425, was enabled, through the remarkable researches of Bro Otto, to demonstrate some of the objective proofs that are to be discovered in Bushman cave shelter paintings in the Cape Province, Natal, and Rhodesia of alien intruders wearing headgear of Babylonian and Phrygian appearance

The great age of at least one of the mines was demonstrated by me in "The Rooiberg Cranium" (*S A Journal of Science*, vol 21, 1924), when I pointed out the existence of a stalagmite fifteen feet high and eight feet thick, in its narrowest part, extending from the roof to the floor, thirty to forty feet from the entrance and in such a position as to render practically certain its formation since the period of occupation by the miners

It was, therefore, with considerable confidence that I boldly suggested in my article on "Nickel in Ancient Bronzes" (1924) that, as Sebelien had failed to find nickel carrying ores in the sites of ancient mines in the Arabian and Mediterranean areas, the probable source of the nickel contaminated copper and tin for the ancient Near East was southern Africa

At that time, although it was known that there was ample evidence of smelting operations in the Rooiberg area and a piece of bronze slag had been discovered which had provided in the hands of Mr Schoch the analysis revealing about 3 0 per cent of nickel which has now proved of such significance, there was no conclusive proof that bronze had been intentionally fabricated at Rooiberg

This important corroboration of the view advanced by me was forthcoming at the Pretoria meeting of the South African Association (1926), when Dr Percy A Wagner (*S A Journal of Science*, 1926) revealed the amazing discovery of Mr Gordon of no fewer than thirty distinct furnaces on the farm Blaauwbank No 433 and alongside of some of them small separate stacks of hand cobbed tin and copper ore also accumulations of nodular aluminous surface limestone and hand cobbed iron evidently used as a flux In the furnaces themselves were found slugs' and frills' of bronze, many of them still embedded in an iron rich slag The largest slug weighs 31 3 grammes"

Here, then, as Dr Wagner stated is definite proof for the first time that these ancient metallurgists had deliberately set out to make bronze, and that they were thus evidently acquainted with the properties and uses of that important alloy

The reason for the admixture of nickel with the ores at Blaauwbank by the bronze makers was also proposed by Dr Wagner, who pointed out that on the farm there is, in addition to important tin and copper deposits, a nickel lode carrying at the outcrop big masses of apple green nickel bloom' or anabergite This bears a remote resemblance to malachite, and it is probable that the ancient miners, who could not fail to have noticed this outcrop, mistook it for that mineral and thus introduced nickel into their bronze' The objects demonstrated by Dr Wagner are now in the Social Anthropology Museum of the University of the Witwatersrand

Irrespective of any other question there has, therefore, been established by incontrovertible evidence the existence in South Africa of a definite Bronze Age period Such a phase of South African prehistory has not hitherto been recognised by antiquarians, and naturally enough since the bronze objects which in other lands symbolise the existence of such a period have not been found here, but rather only the raw materials of mines, furnaces, and dumps which must have contributed to the blatant bronze cultures of more advanced cultural centres

The second conclusion that is warranted from the facts is that the 'ancient mining period" in South Africa dates back to the Bronze Age, seeing that the

methods of exploitation of the copper, tin, gold, and iron fields are culturally uniform It can scarcely be that the whole industry was of one age its very immensity demonstrates that it must have had several phases The remote antiquity of at least one phase cannot, however, be questioned

It is of the utmost importance that the Bantu peoples when first discovered did not belong to a 'bronze' but to an 'iron' culture, and there is no evidence to show that they evolved through a bronze phase to the iron phase We are forced to conclude that the highly intricate metallurgical processes of bronze making demonstrated by the deposits at Blaauwbank betray the actual presence there at a remote age of skilled and intelligent craftsmen from a superior cultural area Seeing that the deposits are half way across the continent, some estimate may also be arrived at concerning the lengthy period of South Africa's exploitation by that superior race utilising the bronze

To the physical anthropologist who has lived in South Africa and had the opportunity of seeing and dissecting representatives of practically every tribe in the south eastern end of the continent, there is concrete evidence in the thousands of negroid inhabitants with straight, aquiline, and hooked noses, elevated nasal bridges, reduced lip fullness, and lack of prognathism, to demonstrate beyond cavil the flood of Semitic and other Caucasian blood which flows in the veins of the Bantu peoples, just as the presence, in a more reduced proportion, of Mongoloid eye folds, slit like eyes, and high cheek bones of the "Snese Hottentoten" of the Eastern Province and the Bantu tribes of the eastern coast generally reveals past, but probably more recent and less widespread, contacts with the Far East

With regard to the actual date of the Bronze Age in South Africa, it seems clear that being provoked by one or more alien races who were interested in raw bronze and being absolutely dependent upon that alien interest (as the lack of a typical and separate local bronze industry, such as those of Europe, demonstrates), there can be little question that the South African Bronze Age synchronises with the Bronze Ages of the nearest ancient cultures, namely, those of Egypt and Sumeria The importance to South African prehistoric chronology of the further prosecution of this absorbing piece of detective work in metallurgy and the exact chronological establishment of the different ancient mining phases can scarcely be overrated

Fifty Years of Marine Refrigeration

THE important subject of refrigeration on shipboard has recently been dealt with in three papers by Mr A Greenfield, Mr G W Daniels, and Mr H J Ward, read respectively to the Institution of Marine Engineers, the British Association of Refrigeration, and the Institution of Mechanical Engineers

One of the earliest contributions to a technical society on this subject was the lecture of Alexander Kirk to the Institution of Civil Engineers in 1884, while two years later J B Lightfoot read a paper to the Institution of Mechanical Engineers on refrigerating and ice making machinery Associated with the production of artificial cold were the experiments and inventions of Cullen, Leslie, Carré, Gorrie, Tellier, the Bells, Coleman, Linde, Haslam, and others To Gorrie, an American doctor, we owe the first machine which caused compressed and cooled air to expand in working a piston in a cylinder, his patent being taken out on Aug 22, 1850 Five years later, Gorrie died at Apalachicola, Florida, and there are memorials to him in that city and in the Statuary Hall of the Capitol, Washington, D C It was not, however, until about twenty years later that the matter was taken up seriously, and refrigeration on shipboard may be said to have come in definitely with the voyage of s s *Strathleven* in 1879, just fifty years ago The *Strathleven* was fitted with a Bell Coleman cold air machine, and brought home a small cargo of frozen meat from Australia As Mr Ward said, that marked the economic beginning of the industry The Bell Coleman patents were then acquired by the late Sir Alfred Haslam, one of his first machines was fitted in the liner *Orient* in 1881, and in 1889 some 2,000,000 carcases of beef and mutton were brought to England, most of them in ships having Haslam's machines Compressed air machines then began to be replaced by machines using other gases, and to day about 80 per cent of refrigerated cargo ships use carbon dioxide and 18 per cent ammonia, the advantages and disadvantages of which were touched upon by both Mr Ward and Mr Greenfield

Nearly every writer on refrigeration acknowledges the great debt this branch of engineering owes to the scientific investigator, and frequent reference is made to the well known standard treatise, The Mechanical Production of Cold," by Sir Alfred Ewing Refrigeration in all its aspects is almost entirely the outcome of research, and the various investigations now being made by the Food Investigation Board, at the Low Temperature Research Station at Cambridge, and at the National Physical Laboratory, are of great value to the industry

Fish, meat, cheese, butter, apples, oranges, bananas all require different treatment, and the refrigerating engineer is faced with many problems Mr Greenfield's review of the arrangement of a large refrigerated cargo ship is of especial interest With a sectional profile of such a ship, he gave particulars of the mechanical appliances and piping The ship he described has 54 independent insulated cargo spaces of a total capacity of 560,900 cubic feet cooled by 37 miles of brine cooling pipe divided into numerous circuits The temperatures used vary from 10° to 20° F for fish and butter, to 34° to 40° F used for vegetables and fruit Frozen meat is kept between 16° to 24° F, and chilled meat at 29° or 30° F

Fruit was first brought to Great Britain from the

West Indies in 1886 in the s s *Nonpareil*, apples were successfully carried home from Australia in 1888 in the s s *Oceana*, while the banana trade began in 1900 "through the enterprise of a Liverpool shipowner who sought to aid a British colony at the call of a great Colonial Secretary" This trade has grown to such an extent that in 1927 more than 18,000,000 bunches of bananas were shipped from the Gulf ports to depots in Great Britain and European countries

Hitherto, refrigerating machinery has been driven by steam, but compressors and pumps are now sometimes connected to electric motors or to oil engines In one of the fine new Nelson liners, the motor ship *Highland Monarch*, of 14,137 tons gross, which made her maiden voyage last autumn, the insulated spaces have a capacity of 500,000 cubic feet The ammonia compression system of refrigeration with brine circulation is used, the ammonia compressors being driven directly by two four cylinder Diesel engines of 300 horse-power each Brine at four different temperatures is available for circulating through the various chambers, flow meters being used to indicate the amount flowing in each circuit All such installations are erected according to the rules and under the direction of the surveyors of Lloyd's Register, who also periodically inspect the ships on behalf of the insurance and other interests involved During 1927–28 installations were fitted in 62 vessels with a total insulated capacity of 5,500,000 cubic feet, while on June 30, 1928, 424 vessels held the Society's Refrigerating Machinery Certificate with a total capacity of more than 76,000,000 cubic feet of insulated space Ships, however, are but the connecting links between the producers abroad and the distributors at home, and the extensive nature of the refrigeration industry in Great Britain and Ireland can be judged from a glance at the Ice and Cold Storage Trades Directory for 1926, a book of some 236 pages

Evolution through Adaptation[1]

By Dr F A BATHER, F R S

It is a hundred years since Francis Egerton, Earl of Bridgewater, died, leaving a sum of money for the preparation and publication of works "On the Power, Wisdom, and Goodness of God as manifested in the Creation" At least half of the eight Bridgewater Treatises thus engendered exemplified their subject by the fitness mutually subsisting between living creatures and the outer world The facts which by them were so easily explained have presented to us one of the fundamental problems of biology The first question is How far are animals and plants really fitted to their surroundings? Then, if not, why not? And again, in so far as they are fitted, how did they become so?

No living being can be considered without its surroundings, indeed, it is hard in some respects to say where the creature ends and its surroundings begin An individual must be fitted to its surroundings, or must make some effort, conscious or unconscious, to become fitted Thus when we observe the multifarious forms of life fitted adequately, if not always perfectly, to varied habitats and modes of living, we need feel no surprise, and we perceive no difficult problem

Geology, however, has taught us that conditions have constantly been changing, and that the forms of life also have changed, and it has revealed to us a succession of creatures constantly becoming fitted, or as we say adapted, to diverse conditions The problem is no longer the fitness of the individual, but the adaptation of the race or lineage An individual is adaptable, but only up to a point, and any increased fitness of the individual is not—at any rate in the vast majority of cases open to human observation—handed on to the offspring How then are we to explain the fact that numberless series of forms have gradually changed, and so changed as either to accommodate themselves to changing conditions or to become (in most instances) more and more fitted to diverse states of life?

Many answers to this question have been propounded, but, since controversy still continues, it is plain that none of them is wholly satisfactory

A theory of revolutions of the earth's surface, each accompanied by a special creation of fresh forms of life, has long ceased to fit the known facts Even if an external guiding power were admitted, one would still seek to discover the mechanism through which it worked From such a theory it is but a step to the conception of development in definite directions, each according to some predetermined plan Palæontologists have indeed made known to us in various groups of animals numerous series, each apparently following a trend of evolution, and some have claimed each trend as inevitable and accident apart, predestined But it will be realised that any line of evolution, as we look backwards, appears to have been regular and inevitable From eolith to steel axe the ascent is straight and unbroken It is just because the later shape proceeds so naturally and, to all appearance, inevitably out of the former shape that we can speak of an unrolling or evolution But when we examine any such line more minutely we find that matters are not so simple Take the evolution of either the horse or the bicycle and it will be found that there are some side lines which failed to win approval, others that were adapted for special conditions and so diverged, or two stocks of different origin and structure may have been similarly moulded to meet a similar environment and have thus assumed a close resemblance Clearly predetermination cannot apply to such cases, and therefore cannot be called in as a general expression of evolution

Broadly speaking, there is a conflict between the view of evolution as essentially a process of

[1] From the Friday evening discourse, entitled "Lily-stars of the Sea How they Fit their Surroundings," delivered at the Royal Institution on Feb 22

adaptation, and the view that it follows predestined courses The essence of the latter view is that the trends do not necessarily accord with the surroundings, but may indeed run counter to them, so that the lineage ceases to be fitted and comes to an inevitable end Now it cannot be denied that, according to our present lights, there are such examples of evolution at cross purposes with environment Any solution of the problem of adaptation must apply also to maladaptation [8]

The problem may be limited and perhaps clarified if taken in connexion with another generalisation of palæontology—the irreversibility of evolution This, which we owe to Louis Dollo, states that a structure once lost is never regained Should the need again arise for the performance of the same function, some other organ must be modified for the purpose This irreversibility may be extended to the history of the lineage There is, all must admit, a curious parallelism between the development of the individual and that of the race , and, just as the individual's growth never really returns on itself, so is any true rejuvenation excluded from the history of the race More obviously connected with irreversibility is a further generalisation, particularly associated with the name of D Rosa, stating that a race as it progresses loses its power of adaptive change At first it can vary in numerous directions and is not bound to any one road But every step that it takes in one of those directions forbids its return to seek another path Thus by degrees all roads but one are barred to it, and if that one road ceases to lead to salvation, the race must perish

Let us combine these statements of palæontology with the geological teaching that from the beginning the surface of our planet has constantly been changing, a fact that has involved, *inter alia*, changes of climate, changes of depth and salinity in the waters, and migrations of their inhabitants It follows that the surroundings of a race are continuously altering , the race has perpetually to catch up with the change in so far as the external changes proceed in the same direction, so do adaptation and specialisation follow in what seems to be a definite trend Now suppose the external change to be diverted from the normal course, then a race that by its specialisation has cut off all chances of adaptation to the new conditions will necessarily perish Or suppose the external change merely to cease , it does not follow that the internal conditions of the organism will cease to move along the line hitherto found beneficial , thus arises the phenomenon of a trend which, beginning in harmony, has been turned to disharmony

This seems to be a fair expression of well known facts It suggests to us that not only is there irreversibility and a consequent loss of adaptability, but also that there is some tendency for change of form and structure to proceed in a definite direction In most cases the direction will accord with the environment , otherwise the world would cease to be peopled In the remainder, and eventually in all cases, the direction becomes in disaccord , the race dies out, and its place is taken by one more adaptable Hence special evolution of the race is replaced by that general evolution of the world-population which we call progress

Consideration of the two chief theories of the evolutionary process in the light of modern knowledge has seemed to point to this same conception of an internal direction

The Lamarckian theory, thus regarded, implies that a modification of the individual to meet the pressure of the environment is somehow transmitted to the germ cells, and that these produce an altered offspring, or mutant, already in accord with the environment It is generally agreed that characters are transmitted from parent to offspring through the chromosomes or nuclear elements of the germ-cells Now it is known that change of outer conditions (food, light, temperature, moisture, and the like) may have such a physico-chemical action on these chromosomes as to induce some change or mutation , but if, as the Lamarckian theory demands, the mutant produced is just the one that fulfils the requirements, we still have to ask why this should be so

In most cases that appear to exhibit a direct action of some outer physical agent, it may be that the agent merely stimulates mutation, and that among numerous mutants only those survive which harmonise with the environment The remainder may never actually come to birth, and even fertilisation may be hindered by a change in the germ-cell due to external influences Such instances in fact are familiar to geneticists When the stimulus of a changed condition is continued through long ages, the probability of its producing a mutant in harmony with the requirements is enormously increased

In so far as this is a true reading of the facts, it implies that the apparent Lamarckian effect is nothing but a special case of the Darwinian selection But, whereas Darwin called on unstable random variations to provide the material for natural selection, Mendel, De Vries, Morgan, and others have shown that the new material really consists of stable, true breeding mutants So far from upsetting the Darwinian theory, that emendation makes it more workable , and if to it we add the conception of an early massacre of unsuitable mutants, the tempo of the selective process will be further accelerated

It is possible to imagine still greater speeding up by viewing selection at a different angle The Darwinian regards what he calls Nature—that is, the totality of environment—as the selector But what if we lay the burden of selection on the creature ? No more in this case than in the former is any conscious choice implied An animal with defective pigment and sight will not escape its enemies unless it skulk in dark corners A mutant that can exist only in warmer water than that supported by its parents will perish if it do not find such a habitat Individuals that happen on suitable conditions will be saved

[8] "Examples of suicidal evolution," mostly instances of excessive calcification are well discussed in various works of W D Lang, who has recently given a brief summary, Form in Fossils, *Proc Geol Assoc* , 39, 429-44, January 1929

A population is subject to both kinds of selection Whether the environment of a given locality change or no, the fit among the offspring that remain in it are passively selected by Nature, those that migrate, because uncomfortable, actively, though accidentally, select a fit habitat Thus arises divergence

If the problem of adaptation is brought nearer to solution by these modern extensions of theory, there remain the questions of irreversibility and trends, especially those that seem to us out of harmony with the environment Those phenomena suggest a tendency of mutation to follow the change of environment, and they do so far more than the rare and somewhat doubtful instances in which an experimenter claims to have produced a heritable modification, or a mutant conforming to some modification that he has produced by outer stimuli in the adult parent If, then, we could find some general principle governing mutation, we might approach an explanation of the whole evolutionary process

May I suggest a possible direction of search for such a principle? The evidence thus far available indicates that mutation depends on some physico chemical change in the particles that make up the chromosomes of the male and female germ cells That chromosome particle, or gene, on which a certain structure of the adult is believed to depend, must have a chemical constitution more complicated than that of any organic compound as yet elucidated by chemists, but the changes in its composition must follow the same laws

The ordinary chemical changes of living substance are reversible, that is a character of life, a compound broken down is at once reformed But certain reactions are irreversible, and conspicuous among them is the whole process of growth and senile decay If, then, some external agent produce a change in the molecular arrangement of a gene, that change may well be irreversible Indeed, the mere removal of the external agent could not be expected to cause a reversal of the reaction Again, just as other irreversible changes in an organism proceed in definite directions, so a succession of changes initiated in a gene would be likely to follow a single line Whether a chemical change consist in the loss of a molecule or in a rearrangement of molecules, it seems that the number of possible changes would become increasingly limited This limitation would, in course of ages, apply to each of the genes

If the changes in the genes were merely random, then the organism would be just as likely to vary in a negative as in a positive direction But if the evidence convinces us that variation is more in a positive direction, then the changes in the genes cannot be random, but must be produced or controlled by some factor external to them

How, precisely, external influences are conveyed to the chromosome particles is another question Some researchers, as J T Cunningham, rely on the action of hormones, internal secretions conveyed by the blood to the germ cells But what happens when the hormones get there? The chromosomes lie in the plasma of the germ cell, and it has long been recognised that this is not without effect on inheritance Now Hirata has recently described a chemical mechanism by which a change in this plasma acts to some extent on the gene At first the influence is manifested in the adult offspring as a non heritable modification, but it is suggested that a continuance and intensification of the stimulus might be so firmly impressed on the gene that the change would be passed on to the offspring Thus the modification would become a mutant, and our problem would to that extent be solved

I have attempted to keep my speculations consistent with recent work in genetics and bio chemistry If some such physico chemical structure be admitted as the basis of variation, and if the irreversibility of the chemical changes in it be allowed, then it seems to provide that fundamental premise from which, in combination with a varying environment, one can deduce irreversibility of evolution, reduction of variation, and orthogenetic trends The decisive principle is still natural selection, but the material on which selection acts is not supplied at random, it is subject to certain laws, and those laws assist the progress of that evolution of life which is revealed to us by palæontology

Obituary.

DR H BRAUNS

HANS HEINRICH JUSTUS CARL ERNST BRAUNS, who died on Feb 3 at his residence in Willowmore, Cape Province, at the age of seventy-two years, was born in Hannover, Germany, and spent his school-days in Mecklenburg, where he also entered the University, obtaining the Ph D degree He studied medicine at several places, including Göttingen and Leipzig, from which latter university he obtained the M D degree The honorary degree of D Sc was conferred upon him in 1928 by the University of Stellenbosch in recognition of his services to entomology in South Africa He was a member of the Royal Society of South Africa, and shortly before his death was elected an honorary member of the Société des Sciences Naturelles, Musée du Congo Belge, Tervueren

On the completion of his medical studies, Brauns travelled in the East, India, and North, Central, and South America In 1895 he went to South Africa, settling eventually at Willowmore in the Karoo, where he worked until 1925

Brauns collected insects all over South Africa, but mostly from the Karoo His chief interest was centred in Hymenoptera, his collection of which is now in the Transvaal Museum, Pretoria He published numerous papers, memoirs, and monographs on South African Hymenoptera, especially on the Apidæ, Sphegidæ, Masaridæ, and Chrysididæ, and his systematic work on genera such as

Cerceris, *Crocisa*, *Epeolus*, etc, is important He was a keen observer and first class field naturalist, and his many observations on the habits, development, nest building, prey parasites, food plants, and general bionomics of Hymenoptera have earned for him a prominent position as an entomologist He also contributed to our knowledge of termitophilous and myrmecophilous insects His indefatigable spirit prompted him to collect even up to the last, and shortly before his death he published descriptions of new Chrysididæ

THOMAS OWEN BOSWORTH, who died in London on Jan 18 last, was born at Spratton, Northamptonshire, on Mar 28, 1882 He was educated at St John's College, Cambridge, and was on the staff of the Geological Survey of Scotland in the years 1908 and 1909 The remainder of his life was mainly spent abroad as an oilfield geologist In this capacity he travelled extensively in America, ranging from Peru to within the Arctic circle His published works include " The Keuper Marls around Charnwood " (Leicester, 1912), " Geology of the Mid Continent Oilfields, Kansas, Oklahoma, and North Texas " (New York, 1920), " Geology of the Tertiary and Quaternary Periods in the North West Part of Peru " (London, 1922), and several papers in the *Geological Magazine* In the work on Peru, Bosworth gives a fascinating account of the later geological history of the region, and his description of the present conditions and processes in the desert is full of interest to both geologists and geographers By his death at the early age of forty six years, geology has lost a very able investigator

News and Views

THE Soviet Government has now completed the first part of an extensive electrification scheme which was begun almost immediately after the Revolution A large 80,000 h p hydro electric station has been built on the River Volkhov about 80 miles east of Leningrad The power is supplied to Leningrad by overhead lines at 120 kilovolts The Swedish General Electric Co (Asea) supplied most of the equipment and assisted in the planning of the station Metropolitan Vickers Electrical Company of Manchester also supplied some of the equipment In the communication between the generating and distributing station, the transmission lines are used as part of the circuit The communication between the machine room and the control room is by ship's telegraphs According to Reuter (Moscow), the Soviet Government has also started broadcasting, the control of which has been put in the hands of the Commissariat of Posts and Telegraphs In addition to radio technical and agricultural courses, a university has been opened the lectures in which are all given by radio By means of telephone lines, broadcasting is being extended to isolated villages A very rapid increase in the number of radio listeners is expected According to the estimates of the Commissariat, the number of listeners will have increased by a million before the end of this year Radio theatres have been opened in both Moscow and Leningrad and experiments are being made with radio films On Aug 1 next, a new radio station with a power of 75 kilowatts will be opened in Moscow

IN January this year, Dr T A Jaggar, Director of the Hawaiian Volcano Observatory, predicted that an eruption of either Kilauea or Mauna Loa was to be expected during 1929 The prediction, based on the cyclic behaviour of the Hawaiian volcanoes first recognised by Dana, was made good in spectacular fashion on Feb 20 On that day, Washington received the following radiogram " Kilauea flashed into magnificent eruption at 1 00 A M Hawaii time this morning " We learn from a *Daily Science News Bulletin* issued by Science Service of Washington, D C, on Feb 21, that the opening phase began with vast fountains of lava, spurting to heights of two hundred feet from a long crack in the floor of Halemaumau Pit In twelve hours the pit was filled with a lava lake to the depth of sixty feet By that time the fountains were still playing to a height of a hundred feet, and the level of the lava lake was rising at the rate of five feet per hour Driblet cones formed above the effervescent lava, and from the higher jets liquid drops were blown off to fall at first as pumice but later as clear brown glass relatively poor in gas bubbles Quantities of the fine spun glassy threads known as 'Pelé's hair' have been formed by wind action from the crests of the waves of molten rock The seismograph at Volcano House records a constant tremor, and an inclination from the vertical away from Halemaumau Pit Since the eruption started, constant additions have been pouring into the cauldron as a result of landslides of volcanic detritus from the steep slopes of the sides It is anticipated that the present phase of intense activity will continue for several weeks

MR R A WATSON WATT delivered the Symons Memorial Lecture of the Royal Meteorological Society on Mar 20, taking as his subject " Weather and Wireless " Mr Watson Watt stated that wireless as a means of communication is essential in modern meteorology because it alone is capable of giving sufficiently rapid interchanges of data over wide areas The results of observations made all over Great Britain are in the hands of the central forecaster within an hour, the majority of the data for Europe are received within an hour and a half, and that for the whole Northern Hemisphere within six hours It was announced that an experimental transmission from Daventry of daily weather charts is to commence shortly Wireless has a 'climate' and a 'weather' of its own The weakening of signals over different kinds of country, according to time of day and season, and the dependence of atmospheric disturbance on latitude, place, and time, are climatological in scope The quick period changes, the erratic phenomena of fading, are part of the 'weather' of wireless—atmospherics are its 'rainfall'

MR. WATSON WATT stated that the average atmospheric is a hundred thousand times as strong as a readable signal. They have been known to disturb broadcast reception up to four thousand miles from their place of origin. They originate in thunderstorms and the predominant source of the world's supply of atmospherics at any moment usually lies in a land where it is summer afternoon. The average atmospheric received in England is of such strength as would be sent out by a thunderstorm 2000 miles away. Speaking of the alleged effects of wireless on weather, Mr. Watson Watt stated that the average rainfall of England requires for its production the expenditure of energy at the rate of a third of a million horse power per square mile, night and day throughout the year. The total rate of emission of energy from all the broadcasting stations of Great Britain and Northern Ireland, in the limited periods during which they work, is less than 55 horse power. Any effect of broadcasting on weather would therefore be due to 'sub homeopathic doses' of less than one in a thousand million. The lecture was illustrated by the reception of current weather maps and written forecasts on the Fultograph system, and by demonstrations of the cathode ray direction finder, a visual direct reading instrument used for locating wireless transmitters and thunderstorms.

IN his Friday evening discourse, delivered on Mar. 22 at the Royal Institution, Sir Ernest Rutherford dealt with "Penetrating Radiations." There exists in our atmosphere a type of ultra penetrating rays often called the cosmic rays of about a hundred times the penetrating power of gamma rays. The frequency of vibration of these cosmic rays is from a hundred to a thousand million times greater than that of ordinary light. For ordinary X rays, the quantum of radiation, in passing through the atoms of matter, occasionally interacts with one of the component electrons and the whole wave energy of the quantum is given to the electron, which is set in rapid motion and ionises the matter in its path. The chance of such a conversion of the energy of the radiation, called the photoelectric effect, increases rapidly with the weight of the atom and falls off markedly as the frequency of the radiation is raised. Another process, called scatterings, is also always present. The effect is small for ordinary X rays, but becomes predominant for very high frequency rays. In this process, called the Compton effect, the radiation is scattered and at the same time the electron is set in motion. The scattered radiation is degraded in frequency in amount depending on the angle of scattering. In very penetrating rays, the average frequency of the scattered wave is reduced to about one half for each scattering collision, when about half the energy in the average is given to the recoil electron. Consequently, when a very penetrating radiation passes through matter, recoil electrons of high speed, and degraded radiations, are always present. The experimental information is at present too scanty to fix with certainty the origin and nature of these penetrating rays. It has been suggested that they come from outer space, and represent radiations which arise in the destruction or creation of atoms. The energy of the quantum in the most penetrating radiation measured by Millikan is of the order of 1000 million volts. It may prove significant that radiation of this energy may be expected to arise if the proton can be converted into radiation by a single catastrophic process.

THE Medical Research Council has lately issued three important monographs in the Special Report Series (H.M. Stationery Office). No. 124, by E. G. D. Murray, gives a critical account of the general biology of the meningococcus, the causative micro organism of cerebro spinal fever. No. 125, by Hugh Cairns, is a study of intra cranial surgery, based upon a year's residence as assistant surgeon in Dr. Harvey Cushing's clinic at Boston, U.S.A. The medical reader, even, will be astonished at what can now be accomplished in this branch of surgery, and it is remarked that, apart from the difficulties of diagnosis and surgical approach, the brain is just as amenable to surgery as are the peripheral nerves. No. 126 contains a summary of reports for 1927 from research centres in Great Britain and Ireland on the medical uses of radium. There can now be no doubt that radium is a valuable adjunct, properly applied, in the treatment of cancers. Some inoperable cases are apparently cured, and even when this happy result does not ensue, life is frequently prolonged and the last days of the patient are rendered more comfortable. Much, however, remains to be elucidated as to the proper dosage, and the best method of application, of radium.

THE value of the work carried out at what are termed forest products laboratories is now beyond cavil. The first was established in the United States in Madison, Wisconsin. An important branch of the Research Institute at Dehra Dun, India, is occupied with similar researches, as also a section of the Bureau of Science at Manila in the Philippines. The Forest Products Research Laboratory at Princes Risborough in Great Britain has already been alluded to in NATURE. A pamphlet (No. 9, Melbourne, 1928) has been recently issued in which Mr. A. J. Gibson, a conservator of forests in India, lent to Australia for the purpose of the inquiry, discusses the question of "A Forest Products Laboratory for Australia." Mr. Gibson arrived in Australia in August 1927 and spent four months in visiting all the States of the Commonwealth, his report being based on the results of his investigations. In publishing the report the Council for Scientific and Industrial Research, under the auspices of which the investigation was carried out, states that its publication does not assume 'that the opinions expressed therein are its adopted views nor that it is intended to follow, in their entirety, the recommendations made.'"

As a result of his investigations and tours in which Mr. Gibson acknowledges his indebtedness to the forest and research officers of the various States, he expresses the opinion that the establishment of a central Forest Products Laboratory for the Commonwealth of Australia is advisable. One of the reasons given is a common one, and yet not the less important for that reason. In the past, he says, there has been much overlapping of research work and waste of

money owing to the absence of co ordination between the various States and the Federal Government in this matter He recommends the setting up of a central laboratory, and estimates the rough cost as follows A capital expenditure for erection of buildings and equipment of £49,000, an annual expenditure of £10,400 for the personal staff, and another £8600 for maintenance or a total for personnel and maintenance of £19,000 per annum

VOLUME 2 of the *Bulletin of the Hill Museum* (1928) has recently come to hand The first volume of this publication was completed in 1924, and it is announced that with the commencement of Vol 2 a part will be issued each quarter The journal is devoted to the publication of original papers on Lepidoptera based upon the splendid private collections of Mr J J Joicey, housed in the Hill Museum at Wormley, Surrey Contributions from outside sources are also accepted, provided they deal with collections made for the Hill Museum or are based upon studies carried out there Among the various papers included in this volume, Prof E L Bouvier's finely illustrated account of the Saturniid moths from the East Indies is important on account of the new species and varieties described Mr Arthur Hall's revision of the genus *Phyciodes* and papers by Mr G Talbot (and others) on material from Matto Grosso, Brazil, and the Great Atlas Mountains, are also noteworthy The *Bulletin* is admirably printed, and is illustrated by well executed coloured and other plates The subscription price is 30s per volume, payable to Mr G Talbot at the Hill Museum it is also announced that the *Bulletin* will be sent in exchange for other publications on Lepidoptera

A SEVERE earthquake, that must have shaken a wide area in British Columbia and southern Alaska, occurred on Mar 1 at 2 31 A M (Eastern Standard Time) The epicentre is placed by the seismological section of the U S Coast and Geodetic Survey in lat 53° N, long 122° W, or in the strait between Queen Charlotte Island and the mainland An after shock, almost as strong as the first, occurred in the same place a little more than an hour later (*Daily Science News Bulletin*, Science Service, Washington, D C The epicentre of both shocks lies about 160 miles south east of that of the Alaskan earthquake of Oct 24, 1927, which was probably situated near Wrangell and Juneau in the narrow sounds of the Alexander Archipelago (NATURE, vol 120, p 667) The central areas of the two earthquakes thus seem to occupy a submarine band parallel and close to the western coast of North America.

UNTIL comparatively recent years, earthworms have been regarded as entirely useful animals, as they benefit the agriculturist by opening up the subsoil and improving the general condition of the land, and also they provide a prolific source of bait for inland fishing Under modern conditions, however, they are a nuisance on lawns and golf courses on account of the mounds of earth they build up at the entrance to their burrows, which are unsightly and interfere with play in golf W R Walton (*Farmers Bull*, No 1569, U S Dept Agric) epitomises our present knowledge of the life history and habits of earthworms, indicating the chief species that are of economic importance Earthworms are a favourite food of wild song birds and domestic poultry In the latter connexion it should be noted that the eggs or larvæ of the gape-worm are swallowed by earthworms, and if in their turn these are eaten by chickens, the latter may contract the disease of gapes, for which the mortality is very high among young birds The collection, storing, and rearing of earthworms for sale is a regular industry in fishing areas, and methods used in connexion therewith are described When it is desirable to reduce earthworms, as on lawns and golf courses, various vermicides may be utilised, including corrosive sublimate, ammonium sulphate, powdered arsenate of lead, and mowrah meal In flower pots and flower beds saturated limewater applied freely to the soil will destroy earthworms and not injure the plants

AT the end of the third volume of the *Quarterly Review of Biology* (December 1928) the editor, Prof Raymond Pearl, reports on the cost of the biological books received during the year 1928 These books are classified by origin—United States, Germany, English American (that is, published in England and imported by a branch in America), England, France, other countries In the last named group two expensive books with many plates should be omitted before taking the average price Leaving these two books out of the reckoning, Germany heads the list—the price per page working out at 1 48 cents, the English American at 1 46, British Government publications 1 26, United States 1 14, England 1 09, France 0 45, and United States Government publications 0 21 cents per page Prof Pearl states that the sample of British Government publications was small and does not give an entirely fair representation of the case He points out the low cost of the U S Government publications, and that French scientific books are still marvellously cheap as compared with the commercially published books of the rest of the world There has been a slight fall (4·4 per cent) in the cost of biological books produced in England as compared with 1927, but the German books received were 23 3 per cent higher in cost in 1928 than in 1927, and 35 8 per cent higher than in 1926 The corresponding increases in the price of French biological books were 25 0 and 28 6 per cent, but the absolute price is so low that the increases are scarcely significant Prof Pearl interprets the feelings of many biologists in Great Britain when he states that it is a question whether the German "publishers are not dangerously close to the point in their pricing of scientific books where they will bring into operation that other sad economic law of which the effect is that absolute returns diminish. There can be no great profit in publishing books at such high prices that nobody buys them."

IN accordance with the recommendations of the recent Committee on the organisation of a Colonial Agricultural Service and of the Colonial Veterinary Services Committee, the Secretary of State for the

Colonies has appointed the following Colonial Advisory Council of Agriculture and Animal Health: Mr W Ormsby Gore (temporarily chairman), Mr F A Stockdale (vice chairman), Lieutenant General Sir William Furse, Dr A W Hill, Dr G K Marshall, Dr E J Butler, Prof T B Wood, Dr W H Andrews, Dr A T Stanton, and Mr R V Vernon The Lawes Trust Committee and the Joint Committee on Research in Animal Nutrition of the University of Aberdeen and the North of Scotland College of Agriculture, respectively, have been invited to give their consent to Sir John Russell and Dr J B Orr serving on the Council Mr G H Creasy, of the Colonial Office, has been appointed secretary to the Council No terms of reference have been given, but the Council s functions will be generally those recommended by the Committees named above

THE International Council for the Exploration of the Sea will hold its annual meeting this year in London on April 8 15 Fifteen countries are now represented on it, namely, Belgium Denmark, France, Finland, Germany, Great Britain, Holland, Irish Free State, Italy, Latvia, Norway, Poland Portugal, Spain, and Sweden The headquarters of the Council are in Copenhagen, and it is there that the annual meetings are normally held The Council last met in London in 1920 when it first reassembled after the War On April 12 and 13 special meetings will be held, by the courtesy of the Zoological Society of London, in the Society s meeting rooms, for the discussion of the fluctuations of fisheries and methods of measuring currents On April 17 a joint meeting with the Challenger Society will be held at the station of the Marine Biological Association at Plymouth

A SECTIONAL meeting of the World Power Conference on the 'Complete Utilisation of Water Power Resources will be held at Barcelona on May 15–23, at the same time as the Barcelona Fair It will be followed by visits to places of interest in Spain The meeting is being organised by the Spanish National Committee of the World Power Conference, with the official co operation of the Spanish Government The subjects to be dealt with are general hydrological problems, technical problems of water power utilisation, economic and financial problems, legal problems, protective measures and defence works of undertakings Copies of the technical programme (in English, Spanish, French, and German) with forms of application for membership, can be obtained from The Secretary, International Executive Council, Central Office, World Power Conference, 63 Lincoln s Inn Fields, London, W C 2

THE unique collection made by Mr and Mrs A C Bossom of the crafts of the Indians of British Columbia has been loaned to the Imperial Institute, South Kensington, S W 7, for display during the period Mar 27–May 20 The British Columbia Indian or Siwash is a mixture of the Mongoloids and Red Indians, and this heredity appears in his art, as some of it is similar to that of the Chinese and Japanese. His artistic instinct is more highly developed than that of the Red Indian, because he is a house dweller and not nomadic The exhibits consist of about 1500 articles, illustrating workmanship in wood, metal, bone, ivory, leather, basketry, etc It is a curious fact that these Indians had no pottery The exhibition is open daily on week days from 10 A M to 5 P M and from 2 30 to 6 P M on Sundays Admission is free

THE proceeds of the Daniel Pidgeon Fund for the year 1929 of the Geological Society of London have been awarded to Mr J Selwyn Turner who proposes to investigate the faunal succession in the Coomhoola Grits and Carboniferous Slate of County Cork

AT the annual general meeting of the Geological Society of London the following officers were elected *President* Prof J W Gregory, *Vice Presidents* Dr F A Bather Prof E J Garwood, Dr E Greenly and Mr H W Monckton *Secretaries* Mr W Campbell Smith and Prof W T Gordon *Foreign Secretary* Sir Arthur Smith Woodward *Treasurer* Mr F N Ashcroft

MOTIONS on the subject of nomenclature for consideration by the fifth International Botanical Congress to be held at Cambridge in 1930, should be in the hand of the rapporteur général Dr John Briquet, before Sept 30 next Further information on the programme of work on nomenclature can be obtained from Dr Briquet, Conservatoire botanique Geneva, Switzerland

THE Ministry of Agriculture and Fisheries has issued anew the Leaflet (No 138) on fowl pox which has been re written It gives a complete summary of the features of the disease and its treatment with illustrations The Ministry also carries out veterinary tests for poultry diseases a charge of 3s being made for a post mortem examination and 10s for a complete examination in outbreaks of bacillary white diarrhœa

IN our issue of Dec 1 1928 p 860 an account was given of the Kimberley meeting of the South African Association for the Advancement of Science held on June 29 July 4, 1928 The full report of the meeting has now been issued (Johannesburg South African Association for the Advancement of Science 30s net) In addition to the presidential addresses the volume contains all the papers recommended for publication after presentation at the meeting There are author and subject indexes

EVERY scientific worker must have had the experience of being asked to recommend for popular reading a book in some branch of his own science, and of being hard put to it to find a satisfactory answer The Committee of the Leeds Public Libraries has got over the difficulty by inviting experts to compile, with suitable comments, lists of works dealing with all the aspects of various subjects of popular appeal The lists are published as small booklets at a price of 3d each, and are suggestive library guides In the scientific series the latest to appear are "What to Read in Zoology" by Prof J Arthur Thomson, and "What to Read in Biology" by Prof W J Dakin

MESSRS W Heffer and Sons, Ltd, Cambridge, have just issued a catalogue (No 323) of some 1800 works dealing with agriculture, botany, zoology and biology, chemistry and chemical technology, medicine and physiology, mathematics and physics, including long runs of publications of the learned and scientific societies The list can be had free from the publishers

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —A temporary zoological assistant for work on the zoological collections of the *Discovery*—The Secretary, *Discovery* Committee, Colonial Office, Whitehall, S W 1 (April 7) A full time lecturer on electrical engineering at the Leicester College of Technology—The Registrar, College of Technology, Leicester (April 8) A demonstrator in the department of chemistry as applied to hygiene, at the London School of Hygiene and Tropical Medicine—The Secretary of the School, Malet Street, W C 1 (April 10) A physics tutor at the University Correspondence College—The U C C, Burlington House, Cambridge (April 12) A junior assistant under the Air Ministry, with good general technical knowledge of wireless ground stations, directional wireless and wireless in aircraft, and of development of short wave wireless telegraphy and telephony especially in its use in aircraft—The Secretary, Air Ministry (S 1), Adastral House, Kingsway, W C 2 (April 15) An assistant curator in the Royal Botanic Gardens, Kew—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S W 1 (April 15) A principal of the Shoreditch Technical Institute—The Education Officer (T 1a), The County Hall, Westminster Bridge, S E 1 (April 16) A principal of the Hackney Technical Institute—The Education Officer (T 1a), The County Hall, Westminster Bridge, S E 1 (April 16) An inspector of ancient monuments for Wales—The Chief Inspector of Ancient Monuments, H M Office of Works, Westminster, S W 1 (April 21) A chief inspector of the West Riding of Yorkshire Rivers Board—H F Atter, 71 Northgate, Wakefield (April 30) An independent lecturer in economics at the University College of North Wales—The Registrar, University College of North Wales, Bangor (May 13) An advisory dairy bacteriologist at the Harper Adams Agricultural College—The Principal, Harper Adams Agricultural College, Newport, Salop

Our Astronomical Column

AURORAL ARCS ON MAR 14 AND 16 —Auroral arcs were seen on Mar 14 and 16 at 7 P M by Prof H Bassett and Mr R G Durrant and by several other spectators at Reading On both occasions the phenomenon presented itself in precisely the same position, but it was fainter on Mar 16, the moon's light being stronger The altitude of the brighter part of the arc was approximately 30° above the horizon and its breadth about half a degree The arc stretched over an expanse from south south east to north north west or 180° It passed below Venus, the moon, and Jupiter on one side, and between two bright stars at a considerable distance on the other Mr Durrant refers to the event as being an apparition of the zodiacal light, but the aspect of the latter is usually that of a glow in the shape of a cone He alludes to Sir John Herschel's suggestion that the zodiacal light represents a denser region of planetary material consisting of the tails of comets, while Lord Kelvin considered it as the reflected light from a cloud of meteors revolving round the sun There is very little if any distinction between these views Mr Durrant remarks that if the theory just mentioned still meets with acceptance, this solar crape ring must circulate just within the path of Venus, but the object witnessed in the sky at the middle of March seems to have been consistent with that of an aurora

RECENT SOLAR ACTIVITY —A large metallic prominence was observed by Mr Newbegin at Worthing on Mar 18 at the sun's west limb He states that the prominence consisted of delicate filaments in a series of interlacing arches culminating in a dense mass at the top which was 105″ in height This part was dense in helium (D_3) The observation is of interest because it seems likely that this prominence was connected with the disturbed area embracing the large sunspot described as No 4 in NATURE of Mar 16, p 425 (for Mar 5—date when first seen—read Mar 4) On Mar 11–13 a considerable magnetic disturbance took place, the measured ranges at the Greenwich station at Abinger being 47′ in declination and 300γ in horizontal force The storm began with a very pronounced 'sudden commencement' at 13 9 hr on Mar 11 the large leader spot crossed the sun's central meridian about 20 hours earlier

ANOTHER MINIATURE MAGELLANIC CLOUD —Dr W Baade contributes to *Astr Nach*, 5612, a note on the nebulous object N G C II 1613, the position of which for 1900 0 is 0^h 58 0^m + 1° 25, near 26 Ceti It was found by Prof M Wolf from photographs with the Bruce telescope, and described by him in *Mon Not Roy Ast Soc*, 69, p 91, as a faint nebulous cloud, 30′ by 40 in size, with brighter condensations embedded in it He suggested that it was a cluster of small planetary nebulæ An exposure by Prof H D Curtis with the Crossley reflector did not lead to any decisive result Dr Baade has now taken several photographs with the Bergedorf reflector, with exposures ranging from 50^m to 120^m He describes it as a star cloud of the type of the Magellanic clouds, the longer exposure gives its dimensions as 14′ × 12′, the brightest stars in it are of mag 17 to 18 It appears to resemble N G C 6822, a photograph of this by Dr E P Hubble is reproduced in "Astronomy," by Russell, Dugan, and Stewart, p 804 (1927)

THE LIGHT CURVE OF NOVA TAURI, 1927 —*Astr Nach*, 5613, contains a table and diagram showing the changes in the light of this star, which was discovered at Bergedorf on Nov 18, 1927, by Prof Schwassmann and Dr Wachmann, being then of mag 9 5

The Harvard plates enabled the history of the star to be carried two months further back It was invisible (fainter than 11^m 7) on Sept 11, 8^m 2 on Sept 25, 6^m 0 (maximum) on Sept 30, it sank fairly rapidly to 13^m 5 at the end of the year, there was then a slight revival to 12 5 in March 1928 13 5 was again reached in mid April, after which the star was lost in the sunlight An exposure on Aug 28, 1928, with 30 minutes exposure, gave the magnitude 14 4

The light curve gives no evidence of the rapid oscillations of brightness which were such a conspicuous feature in Nova Persei 1901 a few weeks after the maximum

Research Items

NAGA CUSTOMS —Owing to head hunting troubles in 1923 it became necessary for Mr J H Hutton to make two tours to parts of the Naga Hills not hitherto visited by white men One journey was made in April, the second in October Mr Hutton has published a diary of the two tours as No 1, vol 11, of the *Memoirs of the Asiatic Society of Bengal* Many types of implements, utensils, and weapons entirely new to the author were recorded, also new data relating to the burial and head customs, forms of tatoo, etc, as well as much information supplementary to that noted by the authors of the various monographs on the Naga tribes published by the Assam Government In connexion with the Yungya custom of disposing of the dead in trees, the head being afterwards removed, the sacred tree in question is the *Ficus*, for which some veneration is consistently shown among the Nagas Among the Wa of Burma and the Dusun of Borneo it is the head tree The Mafulu of New Guinea use it much as the Yungya, and the Papuan tribes reverenced it Women in southern India who desire children pay reverence to it, and the Akikuyu of East Africa regard it as the abode of the souls of the dead It is, therefore, suggested that the beliefs about, and veneration for, the fig tree may be a negroid cult spread all over the Indian Ocean which has grown up into Hinduism from below Similarly, a negroid belief may survive in the custom of hanging the combs of bees and wasps in the entrance of houses, a custom witnessed everywhere on the first tour A similar custom is recorded in the Andaman Islands and in the Malay Peninsula Its occurrence in the Andaman Islands certainly suggests a negrito origin

THE PURPOSES OF THE PECTEN IN THE EYE OF BIRDS —In the Doyne Memorial Lecture for 1928, Prof Arthur Thomson discussed the functions of the pecten in the light of certain experiments carried out by him He suggests that this curious structure serves other purposes than the nutrition of the vitreous humour and retina and possibly the regulation of inter ocular pressure Its pigmentation, position, and structure, all suggest that it may act as a dark mirror which reflects as well as absorbs light Rays of light, which in the normal position of a bird's head fall upon the pecten from the zenith, have been shown by experiment to be reflected from it, and can be projected upon some sentient part of the fundus, with the great advantage that, so reflected from a dark mirror, they are deprived of the dazzle and glare of bright sunshine and produce a more defined and detailed image The biological advantage of such a device is obvious, for it means that a bird of prey hovering overhead can be seen even against the sun, and the position of the pecten is such that the threatened victim can fly in another direction whilst still 'keeping an eye' on the source of danger The projection of *two* images upon the fundus may enable birds to estimate distance more accurately, a valuable power where dense foliage has to be traversed at speed Though the pecten in birds is built upon a general plan, it shows remarkable variations in size and form, and these are characteristic of different species

BIOLOGY OF THE BAY OF PETER THE GREAT (SEA OF JAPAN) —The curious peculiarity of the Bay, according to G U Lindenberg (*Priroda*, No 11), is the fact that its fauna is similar in its character to the terrestrial fauna of the Ussuri region. Even the first explorers of Ussuri noted the mixture of such typically northern forms as the fir and cedar, the sable and the arctic deer, with such typical southern forms as the American vine and the Manchurian walnut, tiger and the racoon like dog This is analogous with the aquatic fauna of Peter the Great Bay The conditions which gave rise to this peculiarity are not the same in the cases of the terrestrial and the aquatic fauna The climatic conditions of the great ice age played an important part in determining the character of the terrestrial flora and fauna, whilst the aquatic fauna is greatly influenced by the hydrological regime of the Sea of Japan The occurrence of series of southern forms in the bay during the last three years may be partly explained by hydrological changes of the regime of the bay It cannot be denied, however, that the southern forms were overlooked by previous explorers Such typical representatives of the northern fauna as cod (*Gadus callarias macrocephalus*) and dorse (*Eleginus navaga gracilis*) are found among the fishes of the bay At the same time, many of the southern forms, such as the herring, *Chirocentrus dorab, Sphyrna zygæna, Alectis ciliaris, Priacenthus hamrus*, and others are found in the bay The sword fish, *Trichiurus Japonicus*, the flying fish, *Cypselurus agoo, Stromateoides echinogaster, Hemirhamphidæ, Scombresocidæ, Belonidæ, Mugilidæ, Scombridæ, Monacanthidæ, Tetrodontidæ, Triglidæ, Echeneidæ, Gobiidæ*, and other representatives of southern seas are numerous So far as is known at present, the fish fauna of the Bay of Peter the Great consists of 233 species, belonging to 53 families Quantitatively, the fish fauna is richer than that of other Russian seas, such as the Black Sea, the Baltic, the Arctic Ocean, etc The character of the fish fauna of the Bay of Peter the Great is nearer to that of northern Japan and Korea than to the Okhotsk and the Bering seas

TWO NEW HYDROIDS —A E Briggs describes (*Records Australian Mus*, 16, 1928) two new species of the hydroid genus *Myriothela* collected near Sydney, New South Wales Six species of the genus are known from northern seas and one from antarctic or subantarctic waters The discovery of these two new species considerably extends the known range of distribution of the genus *M australis* was found attached to seaweed thrown up on the beach and may prove to be a shallow water species The specimens range in length from 4 mm to 30 mm *M harrisoni* was found on the under surface of rocks below the level of low spring tides A large number of capitate tentacles is present--up to 1500 in *australis* and up to 600 in *harrisoni* In both species the gonophores borne by one individual are of the same sex Both male and female gonophores have an apical opening representing the velar aperture The salient structural features of *M australis* are described

LEAF FALL IN FROST —It is well known that frost may cause a premature leaf fall, but the relation of this phenomenon to the normal process, in which leaf fall is preceded by the differentiation of a special absciss layer, has seldom been followed in detail Studies of this nature have recently been carried out by Dr Anton Mühldorf, who, in addition to observations in the field in the autumn, exposed plants at various stages of development to freezing temperatures which were produced artificially An account of this work appears in the *Bulletinul Facultatii de Stiinte din Cernauti*, vol 2, pp 267 304, 1928 Briefly, his conclusion is that this leaf fall is a special case of the normal process of leaf abscission, in which the actual separation of the leaf is accelerated as the

result of the changes set in motion by freezing For example, sap is released into the intercellular spaces where its subsequent expansion on freezing facilitates the separation of the cell walls in the region where abscission takes place If, however, leaves have not yet commenced to differentiate the usual specialised abscission layer at the time when they are exposed to frost, they die and decay on the plant and do not fall off before decaying Dr Muhldorf notes that the vacuole sap released by the cell at the moment of death by freezing has a weakly acid reaction, and this may favour the subsequent hydrolysis of the middle lamella, but this factor alone is quite in operative in producing leaf fall unless the usual abscis zone is already differentiated This paper contains a very full discussion of the general phe nomena of leaf fall accompanied by an extensive bibliography in which, however, British and American work is not cited

Coal in South Africa —The Geological Survey of the Union of South Africa has published the third volume of "The Coal Resources of the Union of South Africa" as *Memoir* No 19 of the Survey The first volume contained descriptions of the coalfields of Witbank, Springs, and Heidelberg, and of the Orange Free State, the second volume described the inland coalfields of Natal, and the present volume deals with such of the coal bearing areas of the Transvaal as were not described in Vol 1, together with the coal-fields of the Cape Province The Transvaal area here described comprises the Eastern Witbank coal field, the Bethal coalfield, the Ermelo and Middelburg-Belfast coalfields, the Piet Retief Wakkerstroom coalfield, and a number of less important fields, such as Springbok Flats, Northern Waterberg, Zoutpans berg, and Komatipoort The Cape coalfields appear to be of but little importance, the only area in which coal has been worked to any extent is the Stormberg area, but even here the coal is of inferior quality and the seams are thin and much intermixed with shale bands, so that competition with the Transvaal and Natal coalfields is practically out of the question, and the author of the memoir, W J Wybergh, states that although there are actually many million tons of coal in existence in the Stormberg coalfield, it is highly improbable that it will ever be economically possible to work it apart from very unimportant local require ments The important Transvaal coalfields are fully described, the quantities of coal reserves are carefully estimated and numerous analyses are given, so that the present volume may be looked upon as satis factorily completing the information contained in the two previous volumes on South African coal resources

Palæozoic Insects —The meagre but interesting fauna of the Rhynie chert found in the Old Red Sandstone of Aberdeenshire comprises a minute branchiopod crustacean (*Lepidocaris*) allied to the *Anostraca* (Nature, **118**, p 89, 1926), some arachnids, including the only true mite known in the Palæozoic, and the remains of some minute insects—the only insects known in rocks of earlier date than the Upper Carboniferous These insects, which were first de scribed by Hirst and Maulik, have been re examined by Dr R J Tillyard (*Trans Entomol Soc London*, p 65, 1928), who notes the resemblance of the mandible and antenna to those characteristic of the order Collembola, especially to the family Poduridæ, and concludes that they either belong to that order or are ancestral to it From comparative morphology it is inferred that the primitive Thysanura must also have been in existence in Devonian times The specimens consist of four more or less perfect heads for which the genus *Rhyniella* was established by Hirst and Maulik, and some jaw like structures for which the generic name *Rhyniognatha* is used In part 10 of his series of papers on Kansas Permian insects, Dr Tillyard (*Amer Jour Sci* (5), **16**, p 185, 1928) gives a detailed account of the genus *Lemmatophora*, this has hitherto been referred to the order Protorthoptera, but is now shown to be related to the recent order Perlaria (stone flies), and is taken as the type of a new order, the Protoperlaria The wing of a damselfly (genus *Permagrion*) from the Upper Permian of the Falkland Islands has been studied by Dr Tillyard (*Trans Entomol Soc*, p 55, 1928) It is the oldest known type which can be definitely referred to the sub order Zygoptera of the order Odonata (dragonflies), and is allied to the more primitive form *Kennedya* from the Lower Permian of Kansas The evolution of the order Odonata in Palæozoic times is discussed by Dr Tillyard (*Rec Indian Mus*, **30**, 151, 1928) The characters of the two related orders Protodonata and Odonata are analysed, and it is concluded that the common ancestor is to be found in the Westphalian genus *Brodia* of the order Megasecoptera The evolution of the Odonata in Mesozoic and Tertiary times will be dealt with in the second part of the paper

Ultrasonic Radiation —In the February issue of the *Journal of the American Chemical Society*, Schmitt, Johnson, and Olson describe further experiments on the chemical action of very intense sound waves Iodine is liberated from a solution of potassium iodide, probably owing to the intermediate formation of hydrogen peroxide, since a reaction was obtained when a titanium sulphate solution was irradiated Solutions containing hydrogen sulphide and air be come strongly opalescent after exposure for a few minutes, owing to liberation of sulphur

Earth Current Registration —Dr S K Banerji, Director of the Bombay Observatory, informs us in a recent communication that he has succeeded in register-ing earth currents with lines only 250 yards long, whereas usually lines of some miles in length are employed, in order to minimise polarisation effects at the electrodes He overcomes polarisation difficulties by making the electrodes neutral with respect to the soil, each elec trode being a combination of electropositive and electro-negative metals, the actual composition being found by trial, and varying with the soil The neutrality is not maintained indefinitely, and to avoid frequent removal and scraping of the electrodes, small separate electrodes of the positive and negative metals are sunk, and one or other of these is joined to the main as and when found necessary to correct for any small polarisation current that may develop Such in stallations have been set up at Colaba and Alibag, which are about 15 miles apart, and about 5 and 18 miles respectively from the centre of the Bombay electric railway network Photographic records of the earth currents show the leakage from this network, the oscillations are in excellent agreement with the voltage record at the power station The amplitude of the oscillations of the leakage current is about 110 microamperes at Colaba, and only 5 at Alibag, the reduction in amplitude agrees roughly with that corresponding to laminar flow A plane current sheet of even 5 microamperes is sufficient to disturb the magnetic registers very appreciably Besides the leakage currents, the earth current records show the natural diurnal current variation, and disturb ance currents during magnetic storms

Chemotherapy with Lead Compounds —It is now some years since Prof Blair Bell first published in the

Lancet an account of the use of lead in the treatment of malignant tumours, and his work has attracted a considerable amount of attention Another question which has also been discussed recently is that of the toxicity of organic compounds of lead, for example, lead tetraethyl These two fields of inquiry have lately been combined in an investigation which has been carried out on the chemical side by Dr Erich Krause, of the Technische Hochschule, Berlin, who contributes a paper to the January number of the *Berichte* (vol 62, pp 135 137), and on the pathological side by Dr W A Collier Various organic compounds of lead (and also of tin) are worked into emulsions with a gum arabic solution, and are injected into the necks of mice The tolerated dose of substances applied in this way varies considerably, and does not appear to depend on the solubility Thus triphenyl lead fluoride or triphenyl tin bromide is fifty times as poisonous as diphenyl lead dibromide Aliphatic and hydroaromatic lead compounds are among the less toxic substances, and are therefore used in the treatment of experimental cancer A carcinoma emulsion is injected into mice, after which half the animals are treated once with lead compounds as above The results indicate definite curative effects, the treatment either preventing the development of tumours, or causing tumours to heal after partial development The most effective substances are found to be tri normal propyl lead fluoride, or the less toxic tri iso butyl lead bromide, and lead tetraphenyl and tri cyclohexyl

AUTOMATIC RECTIFIER SUBSTATIONS — Recent statistics show that the owners of railway and tramway systems and lighting and power networks are adopting the policy of making their substations completely automatic This movement began in America, where the need of highly efficient plant is felt very acutely In Europe the economic conditions involve the factors of high labour costs, the eight hour day, and the necessity of safeguarding the workman in the best possible way In the *Brown Boveri Review* for February, a full account is given of the automatic substations this firm has installed for the Brno tramway company in Czechoslovakia Instead of using rotary converters and complicated combinations of standard relays, mercury arc rectifiers are used These are of robust construction In order to connect the rectifier set with the network, it is merely necessary to close two switches When working with rotary converters it is necessary to synchronise the machines and also verify that the polarity has not been reversed after every operation The vacuum in a rectifier is maintained by a pump set which is started working or shut down according to the value of the vapour pressure in the rectifier A time switch automatically closes the circuit breakers This is the first step in operating the substation By means of a remote controlled switch in the distant central power station, the plant is started up or shut down Should the load become excessive, a thermal relay automatically puts the reserve set into operation All the control gear is kept in cases which are sealed and completely dust tight The average daily efficiency of the rectifier substations is stated to be 92 3 per cent This compares with an efficiency of 87 6 per cent for a rotary converter station A brief inspection of these plants is made once a week and their working is controlled in detail every month

PHOTO CELLS —Great progress has been made recently in the development of photoelectric cells or, as they are now more commonly called, photo cells Compared with selenium cells, they are much more trustworthy and consistent, unlike them, their response to variations on the light falling on them is practically instantaneous They have numerous practical applications Most systems of 'talking films,' for example, use these cells, so as to convert varying light impulses into electrical currents which are applied and reproduced as synchronised sound in loud speakers in the cinema Another application of importance commercially is to picture telegraphy Variations of light falling on the photo cell cause electric currents which can be transmitted by land lines and cables and radio, and are then converted into varying light impulses which are recorded on sensitised photographic paper In the February number of the *Osram G E C Bulletin*, the principles of the action of this new development are given The action of the valve depends on the emission of electrons from a suitably prepared metallic surface when light falls on it The photoelectric currents are extremely small, being of the order of one microampere even with strong sources of illumination They have the invaluable property, however, of being proportional to the incident light They can thus be used for most forms of light measurement They can be made sensitive to particular colours, and this enables them to be usefully applied in practical photometry It seems certain that within the next year or two practical photometric measurements will be made by their use Baird uses them in his system of television A special cell can be made which only responds to infra red light invisible to the human eye This can be used as a burglar alarm

A NEW EQUATION OF STATE —Paper 5 of Volume 63 of the *Proceedings of the American Academy of Arts and Sciences* gives an account of a new equation of state for fluids introduced by Drs J A Beattie and O C Bridgeman of the Research Laboratory of Physical Chemistry of the Massachusetts Institute of Technology It is $pV^2 = RT(1-\epsilon)(V+B) - A_0(1-a/V)$ where $B = B_0(1-b/V)$ and $\epsilon = c/VT$, a, b, c are constants and the other symbols have the usual meanings The terms involving A_0 and B_0 represent the effects of the interactions of the molecules of the fluid, while ϵ represents the effects of temperature and density on the time of encounter of the molecules For this equation $(\delta^2 p/\delta T^2)_v$ is always negative but approaches zero at high temperatures and volumes , p approaches RT/V as V increases and $(\delta pV/\delta p)_T$ at low pressures is negative for low and positive for higher temperatures The five available constants of the equation are all readily determined from observed data, and comparisons are made between calculated and observed pressures at 1777 points for ten gases and the average difference only amounts to 0 18 per cent

TANTALUM —An interesting account by G M Dyson of the metallurgy, properties, and uses of tantalum appeared in the issue of *The Chemical Age* for Mar 2 Since its replacement by tungsten for the manufacture of lamp filaments tantalum has been utilised as a substitute for platinum It is unattacked by acids, with the exception of hydrofluoric acid, but reacts with fused alkalis Hence, tantalum cannot always be employed instead of platinum for making chemical apparatus, especially as it is unsuitable for use above red heat, when a superficial oxide film is formed and nitrogen is absorbed Tantalum will absorb all the common gases when heated to a high temperature, and is therefore used in some radio valves since it functions as its own 'getter' and hardens any vacuum in which it is heated Other uses of tantalum are for the manufacture of surgical instruments and for electrodes in electrolytic rectifiers for alternating current

Ultra-Microscopic Viruses infecting Animals and Plants

IN opening the discussion on ultra microscopic viruses infecting animals and plants, held at the Royal Society on Feb 28 and continued on Mar 14, Sir Charles Martin pointed out that the first virus, that of tobacco mosaic, was discovered by Iwanowski, a Russian botanist, in 1892 Five years later, Lœffler and Frosch ascertained that foot and mouth disease of cattle was due to a filter passing contagium, and since that time numerous virus diseases of plants, mammals, birds, insects, and even bacteria have become known These show no common clinical or epidemiological features, and simply form a heterogeneous collection of contagia, all filterable with an infective filtrate and with at present no proved microbial connexion In certain cases distinctive intracellular bodies occur which may be used in diagnosis

Filterability, which gives entry to the group, depends upon numerous and obscure factors Viruses may be good or bad filterers, and this is not simply a question of size That viruses are invisible is merely due to the fact that the finest filters stop particles of about 0 1μ, whilst the limit of microscopic resolution is about 0 2μ The dimensions of virus, probably not less than collargol (20$\mu\mu$), raise the question of the minimum size of living organisms and have suggested the alternative hypothesis that viruses are propagating catalysts Viruses, however, show the characters of living things and there are no essential distinctions save those of size and cultivability Even the latter may be due to a size limitation of their powers of assimilation which renders them obligate parasites, a view supported by the absence of any evidence of saprophytic viruses The study of virus diseases is certainly one of the most important and difficult fields of biology to day

Dr Henderson Smith was prevented by influenza from opening the discussion from the plant side In his communication he emphasised the fact that viruses causing disease in plants are of the same nature as those causing it in animals Some plant viruses attack numerous hosts, whilst others are more narrowly adapted Many viruses can be transmitted by juice or tissue, and these are filterable and highly infective Others can only be transmitted by grafting, and their filterability cannot be determined Probably, in the field, all plant viruses are normally transmitted by insects, in certain cases the relation between a vector and a particular virus is highly specific, and in a few it has been definitely proved that the insect becomes infective only after a period has elapsed since feeding upon a diseased host Such relationships suggest that viruses are some kind of living parasite The intracellular inclusions in certain plant virus diseases give protein reactions but themselves do not seem to be alive The claim that virus disease can be originated *de novo* by inoculation of normal tobacco with normal potato has not been confirmed

Prof P A Murphy emphasised the strong family resemblance between the virus diseases of plants and the difficulties introduced into their study by the fact that many diseases can only be transmitted by grafting or an appropriate insect vector Viruses are not found outside the plant, and there is no good evidence of their culture *in vitro* Fungal and bacterial diseases of plants are local, and the fact that virus diseases are systemic possibly indicates that virus is different in nature from bacteria or fungi Viruses can be attenuated temporarily or permanently, diseases caused are permanent, as a general rule there is no recovery and an attack does not confer immunity Cases of apparent recovery are probably due to the occurrence of carriers, a widespread phenomenon in plant virus diseases

Foot and mouth disease was discussed by Dr J A Arkwright, who said it is notable for its easy filterability and high virulence in dilution The virus is not infectible to other animal species until adapted by passage Infection confers a short immunity, and susceptibility reappears in the same order as the natural susceptibility of different regions in the normal animal During the immune period the blood contains antibodies Foot and mouth vaccine inactivated by formalin confers immunity in guinea pigs and resembles the vaccine of killed bacteria in that the action is proportionate to the dosage The immunity is specific for the three types of foot and mouth and also for the formolised vaccine The properties of the virus do not exclude its bacterial nature, and there is nothing in the available evidence to contradict the idea of its likeness to bacteria The alternative idea of a metabolic product seems unlikely

Mr J E Barnard described some of his efforts to improve microscopic technique, and emphasised the increasing difficulties of observational study as the limits of microscopic resolution are approached His aim is to use light of shorter wave length, which should make it possible to see characteristics of a body smaller than can be seen by visual light A recent development is a dark ground illuminator for ultra violet rays, whereby it is hoped to reduce the exposures to workable limits Mr Barnard showed a number of lantern slides obtained by this method, and in one of bovine pleuropneumonia granules of 0 08μ were clearly revealed He finds that the virus of pleuropneumonia, which consists of vesicles, shows two methods of reproduction, a normal bacillary type and a type quite distinct In his work on this virus he has cultivated two saprophytes of ultramicroscopic dimensions

Experiments on insect transmission of plant viruses were described by Dr Kenneth Smith He thought that the incubation period which had been found in certain vectors might be the time taken for the passage of the virus from the mouth to the salivary juices The virus has no effect on the insect, the period for which vectors remain infective varies with the disease, and two years' experiments have given no evidence of inheritance Lantern slides illustrated his studies of the transmission of potato mosaic to tobacco, and the extraordinary splitting of the virus into a 'needle disease' and an 'aphis disease,' of which the former, but not the latter, may be made lethal to potatoes by rapid transference As an explanation of these 'two' diseases, Dr Kenneth Smith suggests that the sap of tobacco contains a substance which reacts with the saliva of the aphis and so modifies the disease

Dr W E Gye gave an account of his researches on the Rous fowl sarcoma, from which a filter passing virus may easily be obtained capable of producing true tumours giving further infective filtrates There is a group of such filterable tumours of diverse structure showing this power of giving rise to unlimited growth Each gives a filtrate of specific nature The virus shows the properties of other viruses, and its susceptibility to various antiseptics shows the same general range as other organisms, *e g* bacteria In its susceptibility to acriflavine it is similar to pleuropneumonia virus, and it seems of the same order as this virus and also of the same order as visible bacteria.

Prof J C Ledingham opened the second day's

discussion by summing up the impression left on him by the previous contributions, namely, that viruses appear to be like bacteria in most characters save dimensions, that we have not yet exhausted the possibilities of ordinary microscopic vision in the study of viruses, and that one of the most valuable lines of research is the question of virus attenuation in relation to immunisation The importance of the latter is shown in vaccinia and variola, where passage makes feasible vaccination which confers a prolonged immunity With foot and mouth and certain other viruses, the killed virus gives a vaccine conferring a brief immunity but the possibilities of virus attenuation have not been sufficiently exploited in these fields In its attenuation behaviour vaccinia shows inhibitions no different from those of experimental erysipelas, which suggests that the virus resembles visual bacteria No definite opinion can yet be given regarding the nature of the included bodies, which are of uniform size (0 2μ) and behave like staphylococci inoculated under similar conditions Woodruffe and Goodpasture were able to isolate a single body of fowlpox and found it to consist of innumerable elementary bodies Regarding the question of concomitant bacteria, for example, *B suipestis* and swine fever, the action seems to be one of activation of the bacterium by the virus in pigs carrying disease

The more general principles of plant viruses as illustrated in potato mosaic were dealt with by Dr R N Salaman He has been unable to confirm the American results that virus disease may be caused by physiological disturbance due to the introduction of foreign protoplasm into a plant, and thinks that the original results are due to the use of carrier plants Questions of carrying and tolerance underlie all plant studies By inoculation into varieties having different tolerance, it is possible to distinguish viruses producing identical symptoms such as crinkle *A* and *B* Certain viruses, for example, crinkle, are not altered by passage

Prof F W Twort considered that, according to the theory of evolution, we should expect forms of life much more primitive than bacteria, and that such primordial stages might be represented by the viruses Present research methods may not be suitable for the study of such organisms, and entirely new methods are desirable For example, rays below the infra red may be essential to the growth of viruses, and work he has carried out with rays of 21 31 metres wave length has given very promising results

The differences between bacteria and viruses from the immunological point of view were emphasised by Dr C H Andrewes The main character of virus immunity is its solid or absolute character, the condition often lasting throughout life and being related, probably, to the persistence of the virus in the tissues Although viruses inactivated by formalin, etc , confer immunity, it is not possible to immunise or to produce antibodies by heat killed virus In the former case the serum of immune animals contains antibodies different from other known antibodies, and the body's defence against viruses is different from that against visible bacteria

Capt S R Douglas described the electrical behaviour of viruses In all cataphoretic experiments the virus passes to the positive pole The distribution of the virus in the blood in the several stages of certain virus diseases was also referred to briefly

Dr E Hindle gave an account of his experiments on the virus of yellow fever This normally passes moderately coarse filters, but in the mosquito it is arrested even by those of coarsest grain, which suggests the occurrence of an evolutionary process inside the insect's body Dr Hindle thought that the undoubted variability shown by viruses indicated an organismal nature, but the character of the immunity conferred was so different from that in bacterial diseases that virus could not be considered as merely very minute bacteria

Dr W B Brierley emphasised the fact that plant workers give far less value to the character of filter ability than do zoological students In many plant viruses filterability cannot be tested, as the diseases are, under known conditions, not juice transmissible and can only be transferred by grafting or insect vectors Plant viruses exist as numerous strains the virulence of which can in many cases be increased or attenuated Two or more viruses may act in conjunction, producing characteristic diseases which can be analysed and resynthesised experimentally In insect transmitted diseases one insect may carry different viruses or one virus may be carried by different insects, but in certain cases the relationship between virus and insect is amazingly specific, and in at least one case there is a prolonged 'incubation' period The systemic character of virus diseases is not distinctive, certain fungal and possibly bacterial plant diseases being systemic Virus intracellular inclusions have been found in numerous diseased plants, and evidence is accumulating that they are characteristic of particular host virus relationships In spite of certain difficult points such as dimensions, and in the case of animals, immunological characters, a survey of the evidence makes it difficult to visualise the viruses as propagating catalysts or as other than organisms of the same order of life as bacteria

Prof A E Boycott discussed the nature of viruses and briefly summarised views which were published more fully in Nature of Jan 19 He considered that in many ways viruses show the character of ordinary bacteria, whilst in other ways they more resemble the unorganised growth promoting substances and that, as it is all a matter of analogy, which view one accepts depends upon which side one's personal bias tips the scale

A discussion on 'viruses' is rather like what one would expect a discussion on 'insects' or 'bacteria' to be something large and fine, but not a little scattered and diffuse Apart perhaps, from 'the nature of virus,' no coherent thread ran through the contributions The meetings were valuable, however, in bringing together workers from all the fields of virus research and letting them hear and see each other in the flesh.

The Chemical Society in the Industrial North

FOLLOWING the precedent established in 1926, when the annual general meeting and anniversary dinner were held in Manchester, the Chemical Society this year visited Leeds on Mar 21 The proposal to hold such meetings away from London at frequent intervals was one which was immediately commended, the present plan gives many fellows of the Society who for a variety of reasons may find it impossible to travel to London an opportunity of identifying themselves with the activities of the Society, and it also lends an occasion for the greater emphasis, in variously engaged communities, of the part which chemistry plays in modern industry, health, and education, in the modern State, and above all in the world wide development and maintenance of a friendly rivalry in the service of mankind

The official business of the Society was first transacted at a meeting held in the Colour Chemistry Department of the University of Leeds. Afterwards, fellows and others assembled in the Great Hall of the University to receive the presidential address. A cordial welcome was extended to the Society by the Vice-Chancellor (Dr. J. B. Baillie) and by the Lord Mayor of Leeds.

In his presidential address, entitled "Co-operation in Science and Industry," Prof. J. F. Thorpe takes stock of the position in which we find ourselves as a result of the stimulus applied by the War in the direction of scientific achievement, of the developments leading to co-operation in various desirable forms, and of the way in which this stimulus and co-operation are being applied to increase the prosperity of Great Britain. It is, as Prof. Thorpe says, chiefly to the chemical and allied industries that the country turns to increase its productive capacity, its capacity to render available the potential wealth of the nation in a suitable form, whereby alone a universally higher standard of living can be made possible. He is convinced that it is organised industry, relying for its political and financial strength on co-operation—those who hold the keys of national prosperity—who will in the future (if they do not already) call the major chords of the political tune, which is not unreasonable, unjust, or even unlikely, seeing that organised industry both makes it possible to pay the piper and fashions his instrument. By organised industry we suppose Prof. Thorpe to mean the body corporate, composed of capital, and management, and 'labour' (that much abused term, by which we will propose to describe every kind of human service except those accounted for as management and capital)—that body corporate which keeps in the closest possible touch with all sources of new knowledge, with all applications of knowledge both old and new, with human needs, and with national policy.

Four kinds of co-operation, Prof. Thorpe reminds us, are essential to strength: internal co-operation, co-operation with pure science, co-operation with Government, and co-operation with labour. Leaving aside the last, not because of any lack of importance (indeed, this form was described as being "above all" necessary), but merely because the occasion was unsuitable for its discussion, he presents us with an analysis of ways and means, of results and expectations in the domain of the other opportunities for co-operation.

As a concrete example of internal co-operation he selects the common use of hydrogen in three industrial processes: the production of methyl alcohol, of liquid fuels from coal, and of ammonia. Close association of engineers with chemists has been indispensable in order to render possible the establishment of a group of industries so largely dependent on the inauguration and control of reactions under pressure, and on the still empirical employment of chemical 'lubricants,' as catalysts have, not inaptly, been described. There remain, even in the single field of the hydrocarbon industry, vast areas awaiting co-operative exploration. The co-operation required, however, is not exclusively of the strictly scientific kind. Let us suppose that there is a country in the throes of a crisis in its coal-mining industry, yet importing vast quantities of liquid fuel. It is obviously to the advantage of that country literally to liquefy its assets. Science and industry show us that one promising method of producing oils and numerous other valuable raw materials from coal is afforded by the low temperature carbonisation process; but, says Prof. Thorpe, albeit in other and more polished phrases, the unscientific citizens of that country who still burn raw coal on their domestic hearths: no coke, no oil. Again, we are asked to consider the enormous waste of natural gas—millions of cubic feet each day in Canada; twenty-five million cubic feet daily in Persia—and to reflect on what co-operative research might do to utilise it.

Co-operation with pure science is a matter of special moment to our universities, where the human material acquires its knowledge, its impulse, and its outlook, and where opportunities for useful contribution to industrial and national prosperity abound, if only they are made available by support from industrial and national resources. It is, of course, the primary function of the university to attend to fundamentals, both in training and in research; to produce men who are capable of applying their minds with intelligent understanding, with wise vision, with human sympathy, and with appreciation of moral values to the world and its affairs. Prof. Thorpe has special opportunities both to study the inevitable problems and to reach sound conclusions concerning their solution. Discussing the contribution of the universities, so far as co-operation between science and industry are concerned, Prof. Thorpe speaks with experience of the training of the men, pointing out the necessity for research training in order to discover the potential value of a student, and recommending that a higher standard be required of candidates for entry into the honours school. In his remarks on the fundamental research which can be, and is, successfully carried out in the universities, he pays tribute to the far-sighted policy of leading industrial organisations, particularly of Imperial Chemical Industries, Ltd., in affording financial support to enable such studies to be prosecuted under the direction of specialists in various branches of research.

The Government's part in co-operating in science and industry is being exercised in the two most profitable directions in which, in Prof. Thorpe's view, support could be given, namely, on one hand by protection of young and struggling industries, and on the other hand by the promotion of research by means of the establishment of specific inquiry, of financial assistance to industrial groups, and of the provision of research studentships and fellowships. With the present policy of the Department of Scientific and Industrial Research in reducing the number of maintenance grants for students in training Prof. Thorpe expresses dissatisfaction. In fact, he uses words which indicate considerable disquietude: "the outlook is serious"; "it is essential that the State should provide the means for helping to meet this very real national difficulty"; "it is to be hoped that the diminution is merely a temporary expedient." Prof. Thorpe is right in saying that a policy which has provided a steady stream of research workers not otherwise available ought not in any measure to be laid aside while there remains a national need for the best type of research worker. He would be a brave man who would risk his reputation or his roubles in the attempt to prove that the need neither exists in Great Britain to-day, nor is likely to be intensified to-morrow.

In the evening, the anniversary dinner of the Society was held in the Town Hall, the principal guest being Viscount Lascelles, who, in his speech welcoming the Society to the West Riding of Yorkshire, mentioned the special degree to which the prosperity of that part of the country is dependent on co-operation between science and industry. The Lord Mayor of Leeds urged the development of a spirit of collective enterprise, in addition to, rather than instead of, that of private enterprise. The Vice-Chancellor of the University said that the theme of the

address was one which was constantly under discussion in that area it seemed to him that the practical application of science was often more difficult than the fundamental theoretical considerations and he described chemistry as a blend of patience poetry and penetration Prof F Bilmann declared that national feeling is not incompatible with an international spirit in science which is the quintessence of internationality while Prof Max Bodenstein spoke of the common work and the friendship of the workers

Electrical Conductivity in Strong Magnetic Fields

P. KAPITZA has contributed to the *Proceedings of the Royal Society* dated Mar 6 two important papers on the change of the electrical conductivity of metals in strong magnetic fields The first paper is experimental and gives the results of experiments on some thirty five different kinds of metals all of which were subjected to enormous magnetic stresses

In ordinary commercial magnetic testing we rarely go to magnetising forces so high as 50 gauss In Kapitza s experiments the magnetising forces are taken up to 300 000 gauss In order to get consistent results it was found necessary to obtain metals of the greatest purity and to make certain that the metals were all in their normal physical state at the commencement of the experiment Most of the metals were studied at three temperatures at room temperature about 17° C (290° Kelvin) at a temperature of 193° K when the Dewar flask containing the metal under test was filled with a mixture of solid carbon dioxide and ether and finally at a temperature of 88° K when the flask was filled with liquid nitrogen Most of the metals were subjected to both transverse and parallel (longitudinal) magnetic fields

It was found that in all the metals the change of resistance follows the same law which can be expressed by a formula which gives good agreement with the experimental results It shows that in weak fields the resistivity of the metals increases in proportion to the square of the magnetic field but in stronger fields up to 300 kilogauss the increase of resistance is in direct proportion to the magnetic field It is shown that the physical change produced by hardening or annealing the metals has a great effect on the phenomenon of change of resistance in a magnetic field

The experimental results indicate that the resistance can be considered as made up of two components an ideal resistance which is a property of the metal and an additional resistance which is attributed to internal disturbances The ideal resistivity has a constant value for each metal at a given temperature but the additional resistance appears to be independent of the temperature

Kapitza's researches have a direct bearing on the theory of metallic conduction He has proved that both in a transverse and in a parallel magnetic field the increase in the resistance of the metal conductor due to the field is directly proportional to the first power of the applied field His pioneering experiments on the resistance of metals in very intense fields bring this out clearly Modern theories are based on the assumption that the paths of the free electrons are deflected in their motion by the magnetic field They lead to the conclusion that the effect must follow a square law As this is not true the phenomenon cannot be merely due to the obstruction of the paths of the electrons Kapitza gives a theory which assumes that the change of resistance follows a linear law with the increasing field This effect is masked in weak fields by disturbances existing in the metal which are equivalent to that produced by an inside magnetic field He obtains formulæ which agree with the experimental facts and permit the separation of the ideal resistance and the additive resistance which is produced by internal disturbances

It has been observed by Kamerlingh Onnes and others that close to the absolute zero of temperature there is a residual resistance This resistance is the additive resistance which is independent of the temperature

The other component of the total resistance which Kapitza calls the ideal resistance has a constant value for a given temperature in each metal and is independent of the chemical and physical state of the metal Mercury thallium tin lead and indium which are supra conductors were very carefully examined but no exception to the general law in their change of resistance in magnetic fields was observed The experiments definitely indicate that the phenomenon of supra conductivity consists in the disappearance of the additive resistance The resistance of the conductor is then equal to its ideal resistance It follows that supra conductivity is not a phenomenon confined to a few metals but probably exists in all metals The temperature however has to be reduced sufficiently low to make the additive resistance disappear

University and Educational Intelligence

BRISTOL One or more research studentships in experimental physics are being offered for the session 1929–30 The emoluments will be from £200 to £300 and the studentships may be renewed for a second or a third year Further particulars may be obtained from Prof Tyndall to whom applications should be sent before May 25

A studentship in theoretical physics is also offered for the session 1929 30 of the value of from £200 to £300 and the studentship may be renewed for a second or a third year Further particulars may be obtained from Prof Lennard Jones to whom applications should be sent before May 25

CAMBRIDGE —The Amy Mary Preston Read scholarship of value £150 for research in a scientific subject, has been awarded to H D Ursell scholar of Trinity College B H C Matthews Beit Memorial Fellow 1928 has been elected a fellow of King s College

EDINBURGH —At a graduation ceremonial on Mar 21 the degree of doctor of science was conferred on Gwendoline Hilda Faulkner for a thesis on The Anatomy and the Histology of Bud Formation in the Serpulid *Filograna implexa* on Mr J M Gulland for a thesis on The Morphine and Aporphine Alkaloids and on Mr T A Sprague for a thesis on Taxonomic Studies in *Loranthus* and other Phanerogamic Genera

LONDON —Dr Paul Dienes senior lecturer in mathematics at University College Swansea has been appointed as from Aug 1 to the University readership in mathematics tenable at Birkbeck College Dr Dienes was educated at the Presbyterian College of Debrecen Hungary and the University of Budapest where he obtained his doctorate in 1905 On graduation he was appointed lecturer in mathematics at Budapest In 1908 he was given two years leave of absence to study in Paris and obtained the doctorate of the University

of Paris in 1909 From 1918–19 he acted as adviser to the Commissioner for the re organisation of the University of Budapest, and in 1919 he organised the Faculty of Science in the new Calvinistic University of Debrecen, Hungary His publications include "Leçon sur les singularités des fonctions analytiques" (Gauthier Villars, 1913), "Taylor Series an Introduction to the Theory of Functions of a Complex Variable" (Oxford Univ Press, in the press), and numerous papers in French, Hungarian, and Italian scientific journals

The degree of D Sc in anatomy has been conferred on Mr W B Crow (East London College), for a thesis entitled "Contributions to the Principles of Morphology"

An Academic Diploma in Public Health is to be instituted

Oxford —The fifth Annual Report of the Lewis Evans Collection of Scientific Instruments was presented to Congregation on Mar 19 It contains an interesting note on the original carved panels on either side of the east window of the Old Ashmolean Museum The carving represents marine shells and exotic fruits, having a direct reference to the use of the Museum for illustrating the natural productions of lands oversea, an object, as Mr R T Gunther, the curator, points out, always uppermost in the minds of the Tradescants and of Elias Ashmole The report also records a long list of accessions, and speaks with appreciation of the encouragement derived from the inauguration during the year of a 'Society of Friends of the Old Ashmolean"

The electors to the professorship of engineering science propose to proceed to the election of a professor in the course of the ensuing Trinity Term Applications must reach the Registrar not later than April 27

There will be an election to Beit Memorial junior fellowships in medical research in July next Forms of application and all information can be obtained on request by letter addressed to Sir James K Fowler, 35 Clarges Street, W 1 The latest date for the return of application forms is June 1

Applications for a Ramsay Memorial Fellowship for Chemical Research, the annual value of which is £250, with the possible addition of not more than £50 for expenses, should reach the Secretary of the Ramsay Memorial Fellowships Trust, University College, Gower Street, W C 1, by, at latest, June 5

Applications are invited for scholarships for the promotion of research in sanitary science which have been established by the Grocers Company The annual value of each scholarship is £300, plus an allowance for expenses and the tenure is for a year, with a possible extension for a further year or two years Application forms, returnable before the end of April, may be obtained from the Clerk to the Grocers Company, Grocers' Hall, E C 2

The Board of Regents of the University of the Philippines has established a Baker Memorial Professorship in the College of Agriculture This professorship, which is in memory of Charles Fuller Baker, who was dean of the College of Agriculture from 1917 until his death in July 1927, provides for the services in the College of a man from abroad who shall be in residence and teaching in the College eight months at least, and it is proposed to secure men who are specialists in the different sciences allied to agriculture

Calendar of Patent Records

April 1, 1614 —On April 1, 1614, there was granted to William Ellyott and Mathias Meysey an English patent for the first cementation process for converting iron into steel, and steel was successfully produced by the inventors and by Sir Basil Brooke, to whom the patent was transferred in 1618 A second patent containing extended privileges was granted to Ellyott and Meysey, but a clause in it prohibiting the importation of steel created international complications and the patent was revoked

April 1, 1773 —It is not often that an invention is considered worthy of a public monument within a year or two of its birth But this happened in the case of David Hartley's invention for securing buildings against fire by means of thin iron plates laid under each floor and in the ceilings, which was patented on April 1, 1773 The invention was adopted in a number of buildings and received extraordinary support from the Corporation of the City of London, which not only attended officially at a full scale trial of the invention, but erected an obelisk, which still stands, on Wimbledon Common, and made Hartley a freeman of the City Parliament, too, was not far behind It voted £2500 to enable the inventor to carry on his experiments, and extended the duration of the patent for thirty one years from 1777

April 2, 1712 —The first specification of an invention to be enrolled in the High Court of Chancery pursuant to a definite proviso in the patent grant was enrolled on April 2, 1712, in connexion with John Nasmith's patent, No 387, for "the preparing and fermenting of wash from sugar molasses and grain" The wording of the grant shows that the insertion of the proviso, which later became a regular requirement of the Crown, was the suggestion of Nasmith himself (Cf this Calendar, Feb 29 and Mar 13)

April 3, 1449 —The patent granted by Henry VI to John of Utynam on April 3, 1449, for the exclusive right of making coloured glass, is the earliest known example of an industrial monopoly patent in England or any other country John of Utynam came from Flanders at the King's command to make windows for colleges at Eton and Cambridge, and the grant recites that because the said art had never been used in England, and John intends to instruct divers lieges of the King in its practice, no subject of the King is to use it for a term of twenty years, against the will and consent of John, under a penalty of £200

April 4, 1785 —One of the outstanding inventions of the eighteenth century—the power loom—was patented by the Rev Edmund Cartwright on April 4, 1785 Neither this nor his other patents brought much reward to the inventor, but he received a special parliamentary grant in 1809 in recognition of his services to industry

April 5, 1839 —Josiah Marshall Heath's patent, dated April 5, 1839, for the first practical process for the manufacture of manganese steel, gave rise to one of the hardest fought law suits in the annals of British patent law During the protracted proceedings the case at one time or another came before no fewer than 18 different judges—of whom 7 decided in favour of the patentee and 10 against—as well as the Privy Council and the House of Lords, and the final verdict of the latter was not delivered until 1855, thirteen years after the commencement of the suit and after the death of Heath himself The value of the invention to industry was not in question, and the Privy Council recommended the extension of the grant for seven years, but this decision was rendered nugatory and the case brought to a close by the final judgment of the House of Lords against the inventor

Societies and Academies.

LONDON

Geological Society, Mar 6 —**Mrs M M Ogilvie Gordon** Structure of the Western Dolomites She described briefly the stratigraphical succession of the Permian and Triassic rocks which mainly compose the mountain lands of the Western Dolomites, and showed their character in a number of photographic slides Special attention was given to the outbreaks of volcanic action which took place in the Upper Buchenstein and Wengen periods at the close of the Alpine Middle Trias The leading structural features were described, with the aid of the geological map of the Gröden and Fassa district published by the lecturer in 1927

Institute of Metals, Mar 14 —**W Rosenhain** and **W E Prytherch** An improved form of electric resistance furnace Higher available working temperatures (up to 1400° C), durability, and freedom from oxidation of the carbon resistor are claimed The heating element consists of carbon or graphite pellets, or short rods placed end to end in a refractory sheathing tube which fits easily over them Heating occurs by contact resistance The sheathing tube prevents the access of air sufficiently to avoid any appreciable burning of the carbon —**C Sykes** Alloys of zirconium (2) Measurements of electrical and magnetic properties of copper zirconium, iron zirconium, and nickel zirconium alloys show that zirconium gives no material improvement in the properties of the metals, and in certain cases is detrimental Two further partial series of binary alloys are described – aluminium zirconium and silver zirconium The systems exhibit little solubility in the solid state at room temperatures and intermetallic compounds are formed In the low percentage alloys (10 per cent) the compounds crystallise in the form of long, fine needles, and consequently the structure of the alloys is very coarse —**J Newton Friend** and **W E Thorneycroft** The resistance of zinc to indentation (a preliminary account) A machine is described for determining the rate of indentation of zinc by a steel conical die acting under small gravity loads —**J Newton Friend** The solution of plain and amalgamated zincs in electric batteries For use in electric batteries with dilute sulphuric acid or with saturated ammonium chloride solutions, plain high grade 99 9 per cent zinc cannot satisfactorily replace the amalgamated metal or amalgamated pure zinc —**J Newton Friend** and **W E Thorneycroft** The silver contents of specimens of ancient and mediaeval lead Twenty specimens of ancient, Roman, and mediaeval lead have been analysed Spartan lead votive figurines, c 700–500 B C, contain 0 0568 per cent silver, or 18½ oz silver per ton The pre Roman lead does not appear to have undergone any treatment for desilverisation

CAMBRIDGE

Philosophical Society, Mar 11 —**N F Mott** The quantum theory of electronic scattering in helium Born's calculation of the electron scattering in atomic hydrogen is extended to the case of helium The results agree well with experiments of Dymond and Watson —**H M Cave** Note on the number of high velocity β rays By a simple magnetic field method, it is shown that, for radium B + C, the number of β rays having energies greater than 12,000 $H\rho$ must be less than 1 per 500 disintegrations, and is probably less than 1 per 1000 disintegrations —**J L Hamshere** The mobility distribution and rate of formation of negative ions in air The Rutherford Frank Lattey 'alternating field' method of measuring ionic mobilities in a gas has been modified Negative ions in dry air have a continuous mobility distribution between the limits 2 15, 1 15, with a peak value about 1 8 At pressures below 50 mm (Hg) the current is resolved into ions and free electrons The ratios of the ion and electron currents show that the electron makes in air a mean number of $9\ 4 \times 10^4$ collisions before capture, independent of electron velocity over a range 2 to 7×10^6 cm /sec

DUBLIN

Royal Irish Academy, Feb 25 —**Miss M C Knowles** The lichens of Ireland In the arrangement of the list, Praeger's topographical divisions are used and the classification and nomenclature of the "Monograph of British Lichens" 801 species are recorded, among them 7 new to science and 5 to the lichen flora of the British Isles —**Rev R J Doyle** and **H Ryan** Periodic precipitation in the presence and absence of colloids The equation of Jablczynski giving the relation between the distances of bands formed during periodic precipitation in the presence of colloids, and also the equation of Morse and Pierce, hold approximately for the banded precipitation of calcium hydrogen phosphate in the absence of colloids The presence of the colloid cannot therefore be the main factor in the phenomenon It was also shown by means of indicators in gels that the diffusing reagent is far in advance of a point at which a band begins to form The colour changes of the indicators showed clearly that band formation does not occur in the diffusing wave front as some theories of periodic precipitation appear to assume

PARIS

Academy of Sciences, Feb 18 —**L Lecornu** The Clapeyron cycle in the case of saturated vapours —**H Douvillé** The Western Pyrenees at the commencement of the Eocene and the formation of the chain —**V Grignard** and **Tchéoufaki** The additive properties of the α diacetylenic hydrocarbons Oxidation with weak (1 2 per cent) potassium permanganate solution in acid solution gives a product of hydration and not of oxidation stronger solutions (5 6 per cent) give oxidation products The addition of water (sulphuric acid, mercuric chloride) gives always a β diketone Shaking with oxygen gives partial hydration —**T Nagell** The rings of algebraic integers —**A Khintchine** A generalisation of some classical formulæ —**L Lusternik** and **L Schnirelmann** The existence of three geodesics closed on the whole surface of genus 0 —**Th Anghelutza** A new class of nuclei for a Fredholm equation —**Vladimir Bernstein** The singular points of functions represented by Dirichlet's series —**Jacob** The application of Fourier's generalised integrals to the calculus of probabilities —**N Neronoff** A continuous irrotational movement in two dimensions of an indefinite fluid in the presence of a fixed cylindrical obstacle —**Pierre Dupin** A new method of measuring the velocity of fluids based on the use of valve oscillators A description with illustrations of an apparatus showing the velocity of a fluid by a direct reading on a graduated scale It is based on the modification of the wave length of an oscillating circuit produced either by a variation of capacity or by a variation of the self induction of the circuit under the influence of the velocity of the fluid The condenser readings are a linear function of the velocity —**Benjamin Jekhowsky** The corrections of the ephemerids of the minor planets —**A Véronnet** The origin of the planets and the formation of the world —**Y Rocard** Hydrodynamics and the kinetic theory of gases The wall limiting the fluid absorbs molecules

and sends them out according to a law of distribution of velocities other than that of Maxwell Near the wall of the vessel the gas or liquid is no longer a fluid and the equations of hydrodynamics are not satisfied At distances greater than three or four times the mean free path, the ordinary laws of fluids hold —**Jean J Trillat** The orientation of organic compounds by cylindrical glass surfaces and the superficial orientation of the glass —**Ballay** The cathode yield in the deposition of nickel with high current densities The influence of oxidising agents and of the hydrogen ion concentration —**Pierre Bonnet** The tectonic structure of southern Transcaucasia —**Kadlec-Fleck** The synthesis of cyanamide by combinations of carbon and calcium nitride Calcium nitride reacts with carbon at a red heat, giving cyanamide and calcium carbide Between 800° C and 1100° C the rapidity of the reaction increases with the temperature Above 1000° some calcium cyanide is also produced —**Luigi Umberto de Nardo** A new method of colorimetric estimation of nitrates in soils and waters This method is based on the use of pyrogallolsulphonic acid as reagent —**Aug Chevalier** and **W Russell** The sub family of Erisma **P Mazé** The mean temperature of the leaves of maize exposed to sunlight — **Lucien Daniel** The heredity of the ligneous transformations in the descendants of grafted Jerusalem artichoke and sunflower —**Raymond Poisson** The presence in the south of France of an American Hemipter homopter of the family of the Membracidæ *Ceresa bubalus* and its biology This insect which seriously affects certain cultivated plants was noted in France (Eastern Pyrenees) in 1927 and its possible extension must be watched **F Maignon** and **A Painvin** The influence of the seasons on the respiratory combustions of the dog —**Pierre Marié** The arthropods inhabiting the burrows of the Alpine marmots —**E Aubel** The relation between the production of lactic acid and the growth of yeast —**M Javillier** and **Mlles S Rousseau** and **L Emerique** The chemical composition of the tissues in A avitaminosis phosphorus lipoid extract cholesterol **Mlle A Michaux** The total albumens (seroalbumen or serine and serumglobulin) of the serum of guinea pigs suffering from scurvy The presence of albumen and hæmoglobin in the urine of animals at the end of the disease —**E Wollmann** and **Ach Urbain** The reaction of fixation in grafted tumours of mice **R Douris Ch Mondain** and **Mlle M Plessis** The differentiation of normal and pathological sera The oxidisability of the sera The diluted sera were oxidised by a chromic sulphuric acid mixture under comparable conditions The oxidation coefficient expressed as oxygen absorbed, was least for cancerous sera higher for syphilitic sera, and highest for normal sera The coefficients overlap to an extent which deprives the method of diagnostic value

SYDNEY

Royal Society of New South Wales, Dec 5 —**A R Penfold** and **F R Morrison** The chemistry of the exudation from the wood of *Pentaspodon Motleyi* This tree occurs in New Guinea and is identified as close to *Pentaspodon Motleyi* The crude oil was non volatile in steam and could not be distilled without decomposition at 1 mm It contained 90 95 per cent of a new monocarboxylic acid of molecular formula $C_{24}H_{34}O_4$ The silver and copper salts are the only two derivatives which have so far been prepared —**A R Penfold** The essential oil from a pinnate leaf *Boronia* from Frazer Island, Queensland The oil contains 75 80 per cent safrol limonene, etc It differs in composition from all other pinnate leaf *Boronias* so far described, and on account of the inability of botanists to separate it from *B thujona* it is known tentatively as *B thujona, var A* —**M B. Welch** Examination of defective oregon An investigation was made on portion of an electric crane which broke suddenly in Sydney The wood used was oregon, and mechanical tests showed that the wood was extremely brittle and unable to absorb energy due to sudden shocks Usually wood is far stronger in tension than in compression, but with the timber in question there was little difference in this respect It seems possible that, due to continual reversal of the stresses in the member, the wood had become fatigued —**W R Browne** The probable Tertiary age of certain New South Wales soils It is agreed that accumulation of residual sedentary soils is favoured by low physiographic relief, consequently, when such deposits are found in regions of high relief, they may be regarded as relics from the latest stages of the cycle of erosion immediately preceding Some soils occurring around Sydney, on the Blue Mountains, and elsewhere on the highlands, are believed to have been produced during the Tertiary peneplanation, one indication of this is found in the ironstone gravel or hardpan which is so frequent in these soils and must have been formed under physiographic and climatic conditions very different from those prevailing at the present day —**A R Penfold** The essential oil of a new species of Anemone leaf *Boronia*, rich in ocimene —**W R Browne** On some aspects of differential erosion Examples are given from New South Wales illustrating the effect An explanation is developed of anomalous behaviour of rock masses in regard to erosion, whereby rocks like granite really resistant to mechanical wear, are eroded more quickly than less resistant ones These masses may, during the last phases of the preceding cycle of erosion, have suffered deep and thorough decay, so that on the uplift of the region they succumbed very quickly to river attack —**E Cheel** Further notes on the genus *Boronia*, Some of the specimens dealt with were collected about eighty years ago by Allan Cunningham and other explorers who considered them to be good species, but several of these were reduced to mere forms or varieties by Bentham Seven of the earlier names are worthy of rehabilitation to specific rank, and two are proposed as new species —**W R Browne** and **H P White** Alkalisation and other deuteric phenomena in the saddleback trachybasalt at Port Kembla The changes were produced partly by residual solutions, but mainly by post volcanic solutions, which have given rise to zones of progressive alteration roughly parallel to the intrusive contact, the greatest changes being in the intrusive rock These solutions introduced much soda and potash, the former entering into replacive ablite and the latter partly into sericite, but there is chemical evidence that most of the potash is contained in the albite The term 'alkalisation' is proposed to cover cases of magmatic alteration wherein both alkalis are introduced, or in which either base appears in more than one deuteric mineral —**G L Windred** Notes on some organisms of tomato pulp Counts of micro organisms occurring in commercial tomato pulp revealed the presence of large numbers of various species of moulds, yeasts, and bacteria An organism causing sliminess of the pulp was isolated, it resembled *Bacillus ruminatus* Gottheil, but there are marked differences Gas production in sealed metal cans causing the bursting of the containers is due to (1) production of gas from carbohydrates by the organisms, (2) and the action of the acid produced by them on the metal of the container —**M B Welch** Notes on some Australian timbers of the Monimiaceæ The genera described are *Doryphora, Atherosperma, Daphnandra, Mollinedia,* and *Hedycarya* The vessels show scalariform end per-

forations, and are usually very long The wood fibres have more or less bordered pits, and reach a maximum length of almost 3 0 mm in *Doryphora sassafras* A key is given for the identification of the woods, based on the microscopical characters — C Chilton Note on a fossil shrimp from the Hawkesbury Sandstones.

Official Publications Received.

BRITISH.

Journal of the Manchester Egyptian and Oriental Society No. 14. Pp. 72 (Manchester Manchester University Press.) 7s. 6d. net.

University of Leeds. Twenty fourth Report, 1927-28. Pp. 164 (Leeds)

Government of India Department of Industries and Labour (Public Works Branch) Triennial Review of Irrigation in India, 1924-27 Pp. ii+58 (Calcutta Government of India Central Publication Branch) 1 rupee 1s. 9d

Transactions of the Royal Society of Edinburgh Vol. 56, Part 1 No 6 A Contribution to Actinian Morphology, The Genera *Phellia* and *Sagartia*. By Dr T A. Stephenson. Pp 121 189+2 plates 4s. Vol 56, Part 1, No. 7 A Gravitational Survey over the Buried Kelvin Valley at Drumry, near Glasgow By Dr W F P McLintock and Dr J Phemister Pp 141 155+2 plates 3s 6d. (Edinburgh Robert Grant and Son London Williams and Norgate, Ltd.)

The Journal of the Royal Horticultural Society Edited by F J Chittenden. Vol 54 Part 1 January Pp. 252+lxxxiv+xxiv+94 plates (London.) 7s. 6d

Association of Technical Institutions. Agenda Paper and Report of Council (1928) for the Annual General Meeting to be held on Friday February 22nd, and Saturday, February 23rd 1929, at the Grocers Hall, London E C 2 Pp 40 Draft of Paper to be read at the Annual General Meeting, February 22nd and 23rd 1929, on The Relation of Broadcasting to Further Education By C A Siepmann. Pp 18. Draft of Paper to be read at the Annual General Meeting, February 22nd and 23rd 1929 on Technical Training for Women By Miss Ethel E Cox Pp. 10 Draft of Paper to be read at the Annual General Meeting, February 22nd and 23rd 1929, on Industrial Safety By Sir Gerald Bellhouse Pp 10 (London)

Teachers and World Peace a Memorandum for the Guidance of Teachers who desire to explain the Aims and Work of the League of Nations in Schools. Second edition Pp 96 (London League of Nations Union) 6d

The Carnegie Trust for the Universities of Scotland Twenty seventh Annual Report (for the Year 1927 28) submitted by the Executive Committee to the Trustees on 18th February 1929 Pp. iv+168. (Edinburgh.)

The Institution of Electrical Engineers. Edited by P F Rowell Vol 67, No 388 February Pp 217 316+xxxvi (London E and F N Spon, Ltd) 10s 6d.

The South Eastern Naturalist and Antiquary being the Thirty third volume of Transactions of the South Eastern Union of Scientific Societies, including the Proceedings at the Thirty third Annual Congress, held at Rochester 1927 Edited by A. F Ravenshear Pp. lxxv+148. (London.)

The Imperial Forestry Institute *University of Oxford* Fourth Annual Report, 1927-28 and Prospectus. Pp. 19 (Oxford)

Commonwealth of Australia Council for Scientific and Industrial Research Bulletin No. 38 The Chemical Composition of Wool with Special Reference to the Protein of Wool fibre (Keratin) By Hedley R. Marston. Pp 36. Bulletin No 39 The Utilization of Sulphur by Animals with Especial Reference to Wool Production By Hedley R Marston and Prof. T Brailsford Robertson Pp 51 (Melbourne H J Green)

The Engineer Directory and Buyers Guide, 1929 Pp 256. (London *The Engineer*)

Canada. Department of Mines Geological Survey Economic Geology Series, No. 5 Oil and Gas in Western Canada. By G S Hume (No 2138.) Pp. v+152 25 cents Summary Report, 1927, Part C (No 2171) Pp 124C National Museum of Canada, Bulletin No 50 Annual Report for 1926 Pp 126+19 plates (Ottawa F A. Acland)

Report of the Canadian Arctic Expedition, 1913-18. Vol 15 Eskimo Language and Technology Part A Comparative Vocabulary of the Western Eskimo Dialects. By D Jenness. (Southern Party 1913-16) Pp. 134. (Ottawa F A. Acland)

Agricultural Research Council Reports on the Work of Research Institutes in Great Britain, 1927-1928 (Council Paper No 90) Pp 128. (London Ministry of Agriculture and Fisheries.)

Nigeria. Seventh Annual Bulletin of the Agricultural Department, 1st August 1928 Pp 225. (Lagos Government Printing Office London The Crown Agents for the Colonies.) 5s

Royal Society of Arts, John Street, Adelphi London, W C Fund for the Preservation of Ancient Cottages First Annual Report presented at a General Meeting held on February 27th, 1929 Pp. 24 (London.)

India Meteorological Department. Scientific Notes, Vol 1, No. 1 A Comparison of Upper and Gradient Winds at Agra and Bangalore By Mohammad Ishaque Pp 11+7 plates. 1 8 rupees 2s. Scientific Notes Vol. 1, No. 2 An Analysis of the Madras Hourly Rainfall Records for the Years 1865 to 1875 and 1901 to 1917 By V Doraiswamy Iyer Pp. 13 24+1 plate. 9 annas, 1s. Scientific Notes, Vol 1, No 3 Thunderstorms of Calcutta, 1900-1926. By V V Sohoni. Pp. 25-36+4 plates 14 annas, 1s. 3d. (Calcutta Government of India Central Publication Branch.)

War Office Report on the Health of the Army for the Year 1927 (Vol. 63.) Pp iv+144. (London H M Stationery Office) 4s 6d net.

The Costing of Chemical Manufacturing Processes By L. Staniforth Pp. 24. (London The Institute of Chemistry)

Department of Agriculture, Madras Bulletin No 91 A Soil Survey of the Malabar District. By B Viswa Nath and T S. Ramasubramanyan. Pp 9+13 maps. (Madras Government Press.) 1 6 rupees.

The British Chemical Plant Manufacturers Association. Official Directory of Members, 1929 with a Classified List of their Manufactures and Services. Pp 119 (London)

Transactions of the Geological Society of South Africa. Vol. 31 January-December 1928 Pp. 166+24 plates. 42s Proceedings of the Geological Society of South Africa containing the Minutes of Meetings and the Discussions on Papers read during 1928, to accompany Vol. 31 of the Transactions, January-December 1928. Pp. iii+lvi (Johannesburg.)

Transactions of the Optical Society Vol 30 1928-29 No 1 Pp 48. (London.) 10s

Air Ministry Aeronautical Research Committee Reports and Memoranda. No 1169 (Ae 338) The Distribution of Pressure over the Hull and Fins of a Model of the Rigid Airship R.101 and a Determination of the Hinge Moments on the Control Surfaces By Dr R. Jones and A. H. Bell (T 2305) Pp. 37+13 plates 1s 9d. net No 1184 (Ae 347) Experiments on a Model of a Single Seater Fighter Aeroplane in connection with Spinning By H B Irving and A. S Batson (T 2611) Pp. 19+12 plates 1s net No 1187 (Ae. 349) On the Use of a Follow up Mechanism in Aerodynamic Servo Control Systems. By H M Garner and K. V Wright. (T 2687) Pp 8+2 plates 6d net (London H.M Stationery Office)

Department of Scientific and Industrial Research Third Report of the Gas Cylinders Research Committee (Alloy Steel Light Cylinders) Pp. iii+74+18 plates 2s 6d. net. Fourth Report of the Gas Cylinders Research Committee (Cylinders for Liquefiable Gases). Pp v+151 4s net (London H M Stationery Office)

Memorandum showing the Progress and Development in the Colonial Empire and in the Machinery for dealing with Colonial Questions from November 1924 to November 1928 (Cmd 3268) Pp. 81 (London H M Stationery Office) 1s 6d net

The Journal of the Institute of Metals Vol 40 Edited by G Shaw Scott Pp xii+877+38 plates (London) 31s 6d. net

Aeronautics Technical Report of the Aeronautical Research Committee for the Year 1927-1928 (with Appendices). Vol 1 Aerodynamics (Model and Full Scale). Pp viii+431+ix xxiii+182 plates 15s net Vol 2 Stability and Control Autogiros Materials, Engines, etc Pp. viii+438 946+ix xv+187 plates 20s net (London H M Stationery Office)

Proceedings of the Royal Physical Society for the Promotion of Zoology and other Branches of Natural History Session 1927-28. Vol. 21, Part 4 Pp 159-216 (Edinburgh) 6s to Fellows 5s

Department of Agriculture Tanganyika Territory Pamphlet No 2 A Planters Guide to the Production of Arabian Coffee By A E Haarer Pp 81 (Dar es Salaam)

The Daylight Transmission of Wireless Waves over Sea Water By R O Cherry Pp 8 (Melbourne Broadcasting Co of Australia.)

Publications of the Dominion Astrophysical Observatory Victoria, B C Vol 4 No 10 The Composite Stellar and Nebular Spectrum of *Z Andromedae* By H H Plaskett. Pp ii+119 160 Vol 4 No 11 The Orbits of A Persei and H R 8210 By W E Harper Pp 161 168 (Ottawa F A Acland)

Records of the Indian Museum Vol 30 Part 3 October 1928 Pp 217 373+plates 8 11 2 12 rupees 5s Vol 30 Part 4 December 1928 Pp. 375 468+plates 12 14 2 12 rupees 5s (Calcutta Zoological Survey of India.)

Air Ministry Aeronautical Research Committee Reports and Memoranda No 1172 (Ae 336) The Effect of Wind Weight and Atmospheric Conditions (including Semi Tropical Conditions) on the Distance to Take-off and Land an Aircraft. By Flight Sergt H H Rolles and H L Stevens (T 2620 T 2640 and a) Pp 14+7 plates (London H M Stationery Office) 9d. net.

University College of Wales Aberystwyth New Varieties and Strains from the Welsh Plant Breeding Station No 1 Pure Lines of Hen Gymro Wheat Selections made by T J Jenkin (Leaflet Series S, No 1) Pp 16+6 plates (Aberystwyth.) 1s

University of Bristol Lewis Fry Memorial Lectures 1928-29 Science and Drama. Lectures delivered by Prof C Lloyd Morgan on November 15th and 16th 1928 in the Great Hall of the University Pp 38 (Bristol)

Armstrong College Newcastle upon Tyne Standing Committee for Research Report for 1927-1928 Pp 28 (Newcastle upon Tyne)

Proceedings of the Royal Irish Academy Vol 38, Section A, Nos. 4 5 Recombination of Ions in Atmospheric Air Part 1 Investigation of the Decay Coefficient by Schweidler's Method by Dr P J Nolan and Cilian O Brolchain Part 2 The Law of Recombination of Ions and Nuclei, by Dr P J Nolan. Pp 40 59 6d Vol 38, Section B No. 9 The Pre-Glacial Topography of the Liffey Basin By Anthony Farrington Pp 148 170+plates 6-7 1s Vol 38 Section B Nos 10 11 The Condensation of Aldehydes with Nitro-Diacetoresorcinol by Dr Joseph Algar and Nora M MacDonnell Dichalkones derived from Diacetoresorcinol, by Dr Joseph Algar and Patrick J Hanlon Pp 171 178 6d. (Dublin Hodges, Figgis and Co London Williams and Norgate, Ltd)

The Textile Institute List of Members and Lists of Fellows and Associates as at 31st January 1929 Pp 64 (Manchester)

Proceedings of the Royal Society Series A, Vol. 123, No. A791, March 6 1929 Pp 372. (London Harrison and Sons, Ltd) 12s

Journal of the Royal Statistical Society New Series, Vol 92 Part 1. Pp 162+xii. (London) 7s. 6d

Final Report of the Committee on Industry and Trade (Cmd 3282) Pp. vi+338 (London H M Stationery Office.) 5s. 6d net

FOREIGN.

Report of the Danish Biological Station to the Board of Agriculture. No 34 1928 Pp 125 (Copenhagen C. A Reitzel.)

Carnegie Institution of Washington Year Book No. 27 July 1, 1927, to June 30 1928, with Administrative Reports through December 14, 1928 Pp. xix+438. (Washington, D C Smithsonian Institution)

Bulletin of the American Museum of Natural History Vol 56, Art. 7 Critical Observations upon Siwalik Mammals. By W D Matthew Pp. 437 560 (New York City)

Bulletin of the Interior Bureau of Education Bulletin 1928, No. 18 Major Trends of Education in other Countries. By James F Abel. Pp. 48 (Washington, D C Government Printing Office) 10 cents.

State of Illinois. Department of Registration and Education Division of the Natural History Survey Bulletin Vol 17 Art. 5 Some Properties of Oil Emulsions influencing Insecticidal Efficiency By L. L. English. Pp 233-259 Bulletin Vol 17 Art. 6 Some Causes of Cat-facing in Peaches By B A. Porter, S C Chandler R. F Sazama. Pp. 261 275 Bulletin Vol 17 Art. 7 The Biological Survey of a River System—its Objects, Methods and Results By Stephen A Forbes. Pp 277 284 Bulletin Vol 17 Art. 8 The Knothead Carp of the Illinois River By David H Thompson Pp 285 320 Bulletin Vol 17, Art. 9 Methods and Principles for Interpreting the Phenology of Crop Pests By L. R. Tehon Pp 321 346 Bulletin Vol. 17 Art 10 An Account of Changes in the Earthworm Fauna of Illinois and a Description of one new Species By Frank Smith Pp. 347 362 Bulletin Vol 17 Art 11 The Hessian Fly and the Illinois Wheat Crop By W P Flint and W H Larrimer Pp 363 385 (Urbana, Ill)

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Collection des travaux chimiques de Tchécoslovaquie Rédigée et publiée par E Votoček et J Heyrovsky sous le patronage de la Regia Societas Scientiarum Bohemica. Année 1 No 2 Février Pp 65 136 (Prague)

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Department of Commerce U S. Coast and Geodetic Survey Special Publication No 151 Comparison of Old and New Triangulation in California. By William Bowie Pp iii+50 (Washington D C Government Printing Office) 15 cents

Supplement 33rd to the Bulletin of Applied Botany of Genetics and Plant Breeding Agricultural Afghanistan (Composed on the Basis of the Data and Materials of the Expedition of the Institute of Applied Botany to Afghanistan) By Prof N I Vavilov and D D Bukinich Pp iii+610+xxxii+28 plates (Leningrad) In Russian with summary in English

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Bulletin of the Peking Society of Natural History Vol 2 Part 3 Enumeration of Plants collected by the late Mr Nathaniel Harrington Cowdry in Chihli Province (and Chefoo) (including Contributions made by Dr Bernard E Read Mr Joseph Hers Mrs. A B D Fortuyn and Mr J C Liu to the Herbarium of the Peking Union Medical College) By Lin Ju Chiang Pp x+47 194 2 dollars Vol 3 Part 2 A Compendium of Minerals and Stones used in Chinese Medicine from the Pen Tsao Kang Mu Li Shih Chen 1597 A D Compiled by B E Read and C Pak Pp. iii+120 1 50 dollars (Peking)

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Report of the Aeronautical Research Institute, Tokyō Imperial University No 46 Hūtō no Kabe ga Mokei no Yōryokū keisū ni oyobosu Eikyō ni tuite (On the Effect of the Wall of a Wind Tunnel upon the Lift Coefficient of a Model) By Tatudirō Sasaki Pp 149 193 0 42 yen No 47 Directional Observations of the Radio-Atmospheric Disturbances By Iiichi Obata Yukio Munetomo and Yahei Yoshida. Pp 195-212+12 plates 0 60 yen (Tōkyo Koseikai Publishing House)

Publications du Laboratoire d Astronomie et de Géodésie de l Université de Louvain Vol 4 1927 Pp 258 (Louvain)

Buletinul Facultăţii de ştiinţe din Cernăuţi Vol 2 Fasc 2, 1928. Pp iv+267 487 (Cernăuţi Roumania)

Berichte über die Verhandlungen der Sächsischen Akademie der Wissenschaften zu Leipzig Mathematisch physische Klasse Band 80 No 5 Pp 278 356 (Leipzig S Hirzel) 3 gold marks

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Columbia University in the City of New York Bulletin of Information, 29th Series, No 18 Professional Courses in Optometry 1929-1930. Pp 30+8 plates (New York City)

Department of the Interior Bureau of Education Bulletin, 1928, No 22 Bibliography of Research Studies in Education 1926-1927 Pp vii+162 (Washington D C Government Printing Office) 35 cents.

Ministry of Agriculture Egypt Technical and Scientific Service Bulletin No 79 The Temperature of Cultivated Soil at Giza. By W S. Gray and A. A. Nassar Pp. ii+12+17 plates. 5 P T Bulletin No. 80 Sand Sowing in Cotton Breeding By Gadallah Abouleia. Pp. 19 5 P T (Cairo Government Publications Office)

Bulletin of the American Museum of Natural History Vol. 56 Art. 8 Pleistocene Mammalian Fauna of the Seminole Field Pinellas County, Florida. By George Gaylord Simpson Pp 561 599 Vol 56, Art. 9 A Revision of the Tertiary Multituberculata. By Walter Granger and George Gaylord Simpson Pp 601 676 (New York City)

Department of Commerce Bureau of Standards Miscellaneous Publication No 86 Tables of Spectral Energy Distribution and Luminosity for Use in Computing Light Transmissions and relative Brightnesses from Spectrophotometric Data. *By J F Skogland* Pp 23 *(Washington* D C Government Printing Office) 10 cents

Occasional Papers of the Bingham Oceanographic Collection Peabody Museum of Natural History Yale University No 2 A Contribution to the Osteology and Classification of the Orders Iniomi and Xenoberyces with Description of a new Genus and Species of the Family Scopelarchidae from the Western Coast of Mexico and some Notes on the Visceral Anatomy of Rondeletia By Albert Eide Parr Pp 45 (New Haven, Conn)

Zentralanstalt für Meteorologie und Geodynamik Publikation Nr 132 Jahrbücher der Zentralanstalt für Meteorologie und Geodynamik Amtliche Veröffentlichung Jahrgang 1925 Neue Folge Band 62 Pp xx+A42+B54+C42+D11 (Wien.)

Field Museum of Natural History *Zoological Series*, Vol 15, Part 8 The Marine Fishes of Panama By Seth E Meek and Samuel F Hildebrand (Publication No 249) Pp xxiii xxxi+709-1045+plates 72 102 *Zoological Series* Vol 12 No 15 A new Genus of Aquatic Rodents from Abyssinia By Wilfrid H Osgood (Publication No 250) Pp. 183 189+plate 17 *Zoological Series* Vol 12 No 16 Reptiles collected in Salvador for the California Institute of Technology By Karl P Schmidt. (Publication No 251) Pp 191 201 *Zoological Series* Vol 12 No 17 Notes on South American Caimans By Karl P Schmidt Reports on Results of the Captain Marshall Field Expeditions (Publication No 252) Pp 203 231+plates 16 21 (Chicago)

Field Museum and the Child an Outline of the Work carried on by Field Museum of Natural History among School Children of Chicago through the N W Harris Public School Extension and the James Nelson and Anna Louise Raymond Public School and Children s Lectures Pp 34+8 plates (Chicago)

Library of Congress Report of the Librarian of Congress for the Fiscal Year ending June 30 1928 Pp vi+302+4 plates (Washington D C Government Printing Office)

Department of Commerce Bureau of Standards Research Paper No 39 Reflecting Power of Beryllium Chromium and several other Metals. By W W Coblentz and R Stair Pp 343 354 5 cents Research Paper No 43 Least Retinal Illumination by Spectral Light required to evoke the Blue Arcs of the Retina By Deane B Judd Pp 441 451 5 cents (Washington, D C Government Printing Office)

Scientific Papers of the Institute of Physical and Chemical Research No 176 *A Band Absorption Spectrum of Iodine in an Extreme Ultra* Violet Region By Masamichi Kimura and Michika Miyanishi Pp 33 42 20 sen Supplement No 8 The approximate Content of Gallium in the Green Kaolin from Pan kami On the Existence of Gallium in the Solar Chromosphere By Satoyasu Iimori Pp 4 10 sen (Tokyo Iwanami Shoten)

Diary of Societies

SATURDAY MARCH 30

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemistry Section) (at Museum Leicester) at 8 —Annual General Meeting

TUESDAY APRIL 2

HULL CHEMICAL AND ENGINEERING SOCIETY (at Hull Photographic Society Park Street Hull) at 7 45 —H. E Copp The Future of the Gas Industry

WEDNESDAY, APRIL 3

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society) at 8 —Dr L H Lampitt, E B Hughes and H S Rooke Furfural and Diastase in Heated Honey —J W H Johnson Further Notes on Methods of Sewage and Water Analysis Anti Oxidation and Stabilisation of Pollution —*B J F Dorrington* and Dr A M Ward Potassium Cyanate as a Reagent for the Detection of Cobalt

ENTOMOLOGICAL SOCIETY OF LONDON at 8.

ROYAL MICROSCOPICAL SOCIETY (Biological Section).

THURSDAY, APRIL 4

LINNEAN SOCIETY OF LONDON at 5 —G M Graham The Natural History of the Victoria Nyanza.—Dr G P Bidder On the Classification of Sponges

PHILOLOGICAL SOCIETY (at University College), at 5 30.—Misuse of Language

FRIDAY, APRIL 5

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section), at 7 —E W Hill Some Technical Considerations concerning Power Factor in Relation to Tariffs.

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7 30.—Technical Film showing the Production of Graham Paige Cars in America.

SATURDAY, APRIL 6.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (Yorkshire District) (at Town Hall, Leeds), at 2 30.—Resumed Discussion on the Address by W J Hadfield on The Local Government Bill and the Municipal Engineer, with Particular Reference to the Compensation Clauses.

SATURDAY, APRIL 6, 1929

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No 3101, Vol 123]

Educational Broadcasting

ALREADY we have heard much concerning the powerful influence which broadcasting must have upon what we now accept as civilisation Its effect in helping to break down national and geographical barriers, and its consequent destruction of the suspicions, hatreds, meannesses, and intolerances which ignorance breeds among peoples living within narrow circles, cannot yet be fully estimated That effect is a result of a broad and informal educational influence It is an effect which is inevitable just because broadcasting can not be other than an educational influence If that be the case at present, it is clear that, when the possibilities of broadcasting as a formal and deliberately organised means of education are considered, there can be no doubt that an instrument of incalculable value will be shaped for the service of mankind

The British Broadcasting Corporation is to be congratulated upon the steps it has taken towards linking its activities with the educational system of Great Britain From its early days it has striven untiringly towards that end The history of those steps may be briefly described It began with a committee of inquiry into broadcasting and adult education under Sir Henry Hadow Then followed an interim committee to deal with that specific problem Finally, a central council for broadcast adult education was set up under Lord Justice Sankey That council is composed of representatives of the most important national interests, and it is now completing admirable organisation which will use wireless in the great service of adult education Meanwhile, the famous Kent experiment in the use of wireless to broadcast to schools having been successfully completed, the B B C has just set up a central council for school broadcasting under the chairmanship of the Right Hon H A L Fisher, which is composed of similar national interests to the council we have described above This council is proceeding to deal with the specific problem of broadcasting to schools

The building of such excellent machinery cannot, of course, be productive of anything but good If, then, at the very moment when we wholeheartedly welcome it, we also make one or two suggestions for its use, we feel sure that we shall be acquitted of any desire to make querulous and carping criticism at too early a stage The B B C is, however, a very modern part of modern life, and we would be sorry if it missed the special opportunities it has of taking care that its educational

activities follow, and get the best out of, the changes which are taking place in the structure of our civilisation That does not mean that it should wholly ignore tradition or indulge in a crude stamping upon our special—almost sanctified—academic traditions It means the frank recognition of new values which the changes we have mentioned are presenting us

For our present purposes we have in mind the work of adult education rather than the work of our primary and secondary schools, and we direct attention to what we have called new values because, in a paper on the relation of broadcasting to further education read recently to the Association of Technical Institutions, we see a tendency to make the old distinction between what is called cultural and what is called vocational education "I have often wished," said Mr Siepmann, the author of the paper, "that it were possible to introduce into the technical colleges more subjects representative of the cultural *as opposed to* vocational interests" (our italics) Later he suggested that by "correlating cultural and vocational aims, and by the establishment of a broader basis of instruction, and an attempt to give to the life and work of your institutes a social as well as academic significance," a recruitment of disinterested students would take place Finally, he is "inclined to think that the technical subject [for the purpose of a broadcast talk] is less appropriate than the cultural," and suggested that, while the B B C will go carefully and sympathetically into the matter, there is no "immediate possibility of the extensive adaptation of our programmes to your needs"

If Mr Siepmann thinks that those needs include broadcast talks on engineering or chemistry or building, we are sure he does not yet understand the tone and spirit of the modern technical institution If he thinks that the curriculum of the same institution does not include subjects which he himself would regard as "cultural as opposed to vocational," he is very much mistaken His errors are however, common ones and arise out of the words 'technical education' Much misunderstanding might be removed if Lord Eustace Percy's phrase 'education for industry and commerce' were used It is a term which may be neither entirely satisfactory nor descriptive, but it would help to do away with much of the false distinction between cultural and vocational education—the new phrase under which the ancient and and controversies over, and distinctions between, science and art, tends to be revived

If education is to help in the solution of our problems, we must realise that to treat academic matters apart from social and industrial matters is to fail in all of them What are usually known as academic or cultural subjects are only a part of education In themselves they cannot support life as we know it The spiritual values on which we set so great a store are dependent on what are, at first sight, merely material things But the two cannot be separated Education for industry and commerce can be, and is, used to make men and women realise social relationships Through the grouped course methods of technical institutions, students are shown how one subject is akin to others, how it has value not merely in its own utilitarian content, but also in kinship with others which are at first apparently independent and unconnected

The process is producing a culture which is wider and nobler than our older notions, a culture which is neither lonely nor snobbish, a culture which does not stop short at pleasant abstractions, but is forging a link between the many sides of our world and humanising industry no less than making it efficient Those who know technical institutions know that they are places where is taught not only the art of earning a living, but also the sacred art of living itself

We hope, then, that the B B C 's new educational machinery will not hold too fast to all the parts of academic tradition, that it will realise the vital need for education to march with our changing conditions, that it will be thorough in its examination of phrases like 'cultural and vocational and technical subjects', and that it will regard the changes to which we have referred not as tending to a blind and formless industrialism, but as the outward forms of the newer values which science has made available for us

A Criminal Tribe of India

The Land Pirates of India an Account of the Kuravers, a Remarkable Tribe of Hereditary Criminals, their Extraordinary Skill as Thieves, Cattle lifters and Highwaymen, etc, and their Manners and Customs By W J Hatch Pp 272 + 16 plates (London Seeley, Service and Co, Ltd, 1928) 21*s* net

INDIAN ethnology has been a favourite exercising ground for theorists Recent political developments have done much to encourage them along certain lines Starting from above and adopting the view of a dominant social order, they have

tended to neglect the light to be thrown upon cultural history by direct observation of the more primitive races It is to the credit of the late Sir Herbert Risley, the late Mr William Crooke, and Mr Edgar Thurston, to name some of the principal workers only, that they saw the study of India as a whole and each in his own special province linked up the investigation of primitive and advanced on a basis of observed fact regardless of political or social theory The result is to be seen in Mr Crooke's conclusions as to the relations of the Hindu pantheon and local godlings, and in Mr Thurston's treatment of the out caste and criminal and primitive tribes in the *Madras Gazetteer*

It is inevitable that such reflections should arise on reading Mr Hatch's book on the Kuravers, the tribe whose thieving proclivities have endowed them with the name of 'Land Pirates' It is more than seventy years since officers of the Government whose duties were to prevent dacoity and *Thuggee* first made any study of their peculiarities Yet beyond the notes of police manuals and the accounts in the *Madras Gazetteer*, practically no attempt has been made to give any account of them commensurate with their interest, and this notwithstanding the fact that these nomad thieves are scattered all over the Madras Presidency, as well as in the Canarese Nadu and the Bombay Presidency, and in the Madras Presidency alone number just under two hundred and twenty one thousand The number in the Bombay Presidency also is said to be considerable

The Kuravers are systematic thieves by descent, by habit, and by proclivity They work only when they are not able to steal They wander from village to village but may often earn a lucrative living by a species of blackmail, protecting the villagers from the predatory visits of their fellow tribesmen for a payment Yet the Kuraver, unlike other criminal tribes, as a rule will not kill in order to rob Many of them practise palmistry, the term for which in Tamil is said to be the derivation of their name

It is always interesting, but seldom easy, to trace the origin of a tribe or caste in India General Hervey, the great authority in the middle of the last century on Indian crime, says the tribe migrated from the south, but one version of their origin makes them the descendants of Prince Dharmaraja by a fortune teller (*Kuru*), which would point to a northern descent Their language, however, is Dravidian Physically they are not a low type, and do not differ materially from the other castes of Southern India One story adopted by the Kuravers themselves points to their having at one time lived as hunters and having been driven out by pressure of population Mr Hatch is no doubt right in rejecting the view that they were originally servants of the temples of Southern India, who were supplanted by the arrival of a higher grade of priests

The Kuravers are split up into a large number of divisions, normally each hamlet or settlement containing members of one family only From early times they were distinguished as nomad and settled Four main divisions fall into a number of sub divisions, but there are also other classifications, generally based upon occupation, although this is not necessarily the occupation followed to day Such are the salt merchants, those who split bamboo for the making of baskets, snake charmers, and so on All these ostensible occupations disguise the real occupation of the members of the tribe, which is thieving

The Kuravers worship a number of deities These are, of course, especially propitiated to attain success in thieving expeditions The temple of Subramania at Palni is much frequented by pilgrims Another shrine of great sanctity is that at Chidambaram in South Arcot Magic and superstitious practices loom large in their lives Mr Hatch describes a remarkable belief that a man who has been killed by magic may be resuscitated—a dangerous practice, but one which may prove of great utility, as the nerves extracted from the dead man's legs are most efficacious in the practice of further magic against an enemy

Mr Hatch has had a long experience of the people of whom he writes, but although he describes the tribe and its life very fully and informatively in certain respects, a more systematic account would have been valued In the case of marriage, for example, it is desirable to know what, beyond the bride payment, is the basis of arrangement Marriages are sometimes determined even before the birth of the children, and it is said that a man may claim his sister's two eldest daughters in this way Within what degrees are marriages forbidden or prescribed ? It is also desirable that the position of women should be more precisely defined Mr Hatch implies that their prominence and importance in the Kuraver social system is due in part to the fact that their husbands spend so much time in prison, in part to their utility and their skill in the less important branches of the tribal profession More information upon this and related matters would have been welcome and would have increased the value of this study of a remarkable people

Alchemical Manuscripts.

(1) *Union Académique Internationale Catalogue des manuscrits alchimiques grecs* Publié sous la direction de J Bidez, F Cumont, A Delatte, O Lagercrantz et J Ruska Tome 5 i *Les Manuscrits d'Espagne*, decrits par Prof C O Zuretti, ii *Les Manuscrits d'Athènes*, décrits par A Severyns Pp v + 174 (Bruxelles Maurice Lamertin, 1928) 10 Belgas

(2) *Union Académique Internationale Catalogue of Latin and Vernacular Alchemical Manuscripts in Great Britain and Ireland dating from before the XVI Century* By Dorothea Waley Singer, assisted by Annie Anderson Vol 1 Pp xxiii + 326 (Brussels Maurice Lamertin, 1928) n p

(3) *Union Académique Internationale Catalogue des manuscrits alchimiques grecs* Publié sous la direction de J Bidez, F Cumont, A Delatte, O Lagercrantz et J Ruska Tome 6 *Michael Psellus, Épître sur la Chrysopée , Opuscules et extraits sur l'alchimie, la météorologie et la démonologie*, publiés par Joseph Bidez, en Appendice, *Proclus, Sur l'art hiératique*, *Psellus, Choix de dissertations inédites* Pp xiv + 246 (Bruxelles Maurice Lamertin, 1928) 15 Belgas

THE history of alchemy has a twofold claim on our attention In the first place, it still has its adherents, who are found not merely in the Orient but also in America, Germany, France, and England itself It was recently related that the philosopher's stone had been prepared at Los Angeles by a woman alchemist, who thus takes rank with Mary the Copt and Cleopatra, while M Jollivet Castelot from time to time issues reports of his successful transmutations That this art should flourish even in the twentieth century is a striking witness to human credulity, and as such may engage the notice of psychologists

Secondly, alchemy is the direct ancestor of chemistry, and in view of the modern trend in the philosophy of science, the importance of a study of origins need not be emphasised here Although there are dissentients, it is commonly believed that chemistry arose in the early years of the Christian era, as a result of the fusion of Egyptian metallurgical and other arts with the mystical philosophies of the Neo Platonists and Gnostics Unluckily, the Neo Platonists regarded matter as the principle of unreality or evil, from which the disciple should attempt to detach himself, while the Gnostics cared little for the phenomena of the sensible world, being much more anxious to attain to a knowledge of the invisible cosmos It is significant for the later history of the science that one of the earliest chemical writers, Zosimos the Panopolitan, was a Gnostic, while the Neo-Platonic conceptions of sympathetic action, action at a distance, the distinction between occult and manifest properties, the influence of the stars, and the mystical powers of numbers, all permeate chemistry from its beginnings at the time of Plotinus until the close of the seventeenth century It would, indeed, scarcely be going too far to say that some of these ideas are with us still nitrogen is manifestly inert but occultly active, and the structure of the atom is ultimately a matter of the relations between numbers, as Prof Dingle has observed

To get a clear picture of the development of chemical thought throughout the ages, a great deal of work remains to be done Even the comparatively recent eighteenth century has been insufficiently studied, and the farther we go back the more hazy does our knowledge become The first step to rectify this unsatisfactory state of affairs is obviously an investigation and classification of the material at our disposal The ancient literature of alchemy was incredibly large, and the number of manuscripts which have survived is by no means insignificant The careful cataloguing of these manuscripts has been undertaken by competent scholars under the patronage of the Union Académique Internationale, and the three volumes now under review represent a valuable continuation of the programme of work

(1) The fifth volume of the "Catalogue des manuscrits alchimiques grecs" deals with the manuscripts of Spain, described by C O Zuretti, and those of Athens, described by A Severyns Certain of the Spanish manuscripts furnish useful data for the study of the relations between the principal Greek alchemical works, while others enrich our knowledge of the "Koeranides" The Athenian manuscripts are but five in number, and four of these date only from the eighteenth or nineteenth centuries, the other being of the fourteenth The modern ones are of value as probably representing more ancient works which have to day disappeared or lie hidden in obscure libraries

(2) Of more general interest is the first volume of Mrs Singer's great catalogue of Latin and vernacular alchemical manuscripts in Great Britain and Ireland, dating from before the sixteenth century Mrs Singer's enormous collection of bibliographical data is of course very well known to all historians of science, few of whom are not indebted to her

for information always promptly and generously given. It is therefore with a gratitude partaking of a hope for future favours that we congratulate Mrs. Singer on the appearance of her catalogue and the British Academy on its liberality in bearing the cost of printing it.

In an excellent little introduction, Mrs. Singer explains the direct Greek influence on Latin alchemy. "The iconoclastic disputes in the Byzantine Empire led to the dispersal of artificers, who carried their workshop recipes with them westward. In the work of the eleventh century chronicler, Adam of Bremen, we read of a converted Jew named Paul who, after having visited Byzantium, came to Bremen bringing with him the art of transmuting copper into gold." Several alchemical or rather technological manuscripts of evident Greek ancestry are described in the catalogue, and practical chemistry of a primitive nature was clearly practised in Europe before the great influx of chemical knowledge from Islam in the twelfth and thirteenth centuries. This influx is manifested by the appearance of Arabic names, technical terms, and forms of expression, and in several cases we are in possession of the original Arabic texts of Latin alchemical works. Mrs. Singer's catalogue will doubtless help us to find other such cases, for several of her titles are strongly reminiscent of Arabic alchemical books. We notice, for example, a treatise by 'Mirer,' whom we should guess to be Mahararis, a Muslim alchemist about whom little is known but of whom some writings are extant; and a 'filius Hahmil,' who is undoubtedly Ibn Amyal, as the *incipit* of the manuscript agrees with the opening sentence of an Arabic work by him. These are but foretastes. Mrs. Singer's catalogue is as full of good things as a Christmas pudding and will require even more digestion. We may perhaps direct special attention to the large number of manuscripts in English.

(3) Volume VI. of the Greek catalogue is devoted to a study of Michael Psellus's "Letter on Gold making," by Joseph Bidez, with appendices on certain inedited dissertations of the same writer and a tract of Proclus "On the hieratic art." Psellus, who was professor at the Academy at Constantinople about the middle of the eleventh century, expressed very enlightened views upon the study of Nature. Contemporary indifference to natural phenomena aroused his indignation as only too likely to perpetuate or re-awaken ancient superstitions. He believed in the possibility of the transmutation of the metals, but denied that a knowledge of alchemy was a secret confined to the initiated. The operation of the alchemist, he considered, finds its explanation in the Aristotelian theory of the four elements, from which everything comes by combination and into which everything is resolved by dissolution. Nothing, he says, is produced without cause; belief in prodigies is merely a result of our lack of comprehension of the causes of phenomena. It is not without interest, in view of the fact that at this time Arabic works were being translated into Greek, that Avicenna had expressed an almost identical opinion in 1022, when he wrote (concerning a 'natural wonder'), "These things appear strange only on account of their infrequent occurrence," the wonder vanishing when the causes are known.

One thing emerges very distinctly from the study of ancient scientific treatises. It is that scientific genius and scientific method are not entirely the monopoly of post-Galilean days; but that the great advance which science has made during the last three hundred years is due in no small degree to better co-ordination and transmission of ideas by a much greater number of workers, rather than to any sudden efflorescence of scientific ability.

E. J. Holmyard.

A Hunter-Naturalist's Memories.

Retrospect: Reminiscences and Impressions of a Hunter-Naturalist in Three Continents, 1851–1928. By Abel Chapman. Pp. xix + 353 + 56 plates. (London and Edinburgh: Gurney and Jackson, 1928.) 25s. net.

Mr. ABEL CHAPMAN'S "Retrospect" is a fascinating volume, richly illustrated from his own drawings and with coloured plates of singular beauty from those of the late Mr. Joseph Crawhall. While most of the chapters will appeal chiefly to sportsmen, the author, as a trained and vigilant observer of animal behaviour in many lands, provides just the kind of observation usefully to complement work in the laboratory and the museum. He is puzzled by the enigma how animal and vegetable life can persist in waterless, rainless, dewless African deserts.

"In the Sudan we have two closely related forms of the hartebeest group, namely, the Tiang (*Damalescus tiang*) and the Korrigum (*D. korrigum*), animals so nearly alike that a casual observer would scarce differentiate between them; yet, as regards thirst, as wide apart as the poles in their habits. The tiang is a thoroughly bibulous beast. It inhabits the Steppe regions bordering on the White Nile, and is specially careful to resort twice a day to that river . . . and enjoy two long drinks; . . . the korrigum elects to reside permanently in

the waterless deserts of Kordofan, hundreds of miles from the Nile, and where never a drop of pure water can moisten his torrid throat and tongue year in and year out It is a contrast that passes understanding" (pp 144 5)

Finding it equally perplexing to comprehend how the plants on which the korrigum feeds can exist without water, Mr Chapman put the case before the late Sir Isaac Bayley Balfour, and gives the following extract from his reply

"Plants growing in waterless deserts are variously attuned to their environment Some may store water to tide them over long periods of drought Others, such as the mimosas which you indicate, are able to hold such water as they may obtain in the wood tissues which they form, and also obtain a certain amount from the atmosphere The roots of these plants spread for long distances, and their rootlets attach themselves very firmly to the particles of sand in the soil There may be no *free water* in the soil, and yet an adequate amount of what we call 'hygroscopic water' in the particles, and from these particles the root hairs of plants may get their supplies"

Mr Chapman differs emphatically with those who entertain what he describes as "the Doctrine of Colour Protection," regarding it as "based upon the supposition or superstition that the Almighty had so camouflaged His creatures as to render the harmless invisible to their enemies, while the enemies themselves were equally aided in their predatory avocation by an obliterative coloration" (p 118) This is scarcely a fair summary of the conclusion at which many observers have arrived, which, indeed, is confirmed by Mr Chapman as an experienced field naturalist, for he admits that many animals assimilate so closely in colour to their environment as to be "virtually invisible to the human eye" (p 122), but as they are easily detected when they move, he objects to their colouring being pronounced protective

No one can have given much attention to birds without recognising in how many species colour serves the male for display and the female for concealment during incubation This is almost universal in the duck tribe, although the Sheldrake, *Tadorna cornuta*, presents a significant exception, the female being well nigh as brilliantly garbed as her mate, wherefore hereditary prudence causes her to incubate subterraneously in rabbit burrows

Among fishes also, the remarkable result of Dr Francis Ward's observation from his subaqueous chamber was to reveal how faithfully the glittering sides of certain fishes reflect surrounding water weeds, stones, etc, with protective effect Mr Chapman's long experience in various climes enables him to show that in very many wild animals their colouring is the reverse of protective, but it is unphilosophic to describe as "poetic theorists" (p 133) those who recognise a protective result from the colouring of certain other animals

It is a feature of these reminiscences that while in one chapter the author expresses vigorous dissent from the opinions formed by other naturalists, in another chapter he approves of action founded on those opinions Thus, while he denounces the enactment of a close time for water fowl in Britain as one of the "long drawn bungles of those in high places at the instance of hysterical protectionists" (p 42), he applauds enthusiastically similar legislation which has saved the Spanish ibex, *Capra hispanica*, from extermination (p 99)

A discussion on the maximum speed of flight attained by different kinds of bird is an interesting essay contribution on a difficult problem which Mr Chapman does not claim to have solved, but suggests that, whereas Flight Lieut Webster in the international aeroplane trials at the Lido in September 1927 registered a speed of 289 miles an hour, the speed of bird flight has hitherto been greatly under estimated (Chap xiv)

Since this notice was written, the reviewer has learnt with sincere regret that the author is no more—regret that must be shared by all who esteemed Mr Chapman as an experienced naturalist, a skilful draughtsman, and an entertaining writer

HERBERT MAXWELL

Photographic Star Fields

Isaac Roberts' Atlas of 52 Regions a Guide to Herschel's Fields (avec texte anglais et texte français) Edition commemorating Isaac Roberts' Centenary (1829–1904) By Mrs Isaac Roberts (*née* Dorothea Klumpke) Pp 44+61 plates (London Wheldon and Wesley, Ltd, n d) 42s net

IN the *Philosophical Transactions*, 1811, Herschel gave a list of fifty-two regions in the sky which he described as showing "extensive diffuse nebulosity" Little attention would appear to have been given to the matter at the time, and it was not until 1862, when Auwers reprinted the list, that we find further mention of the fields in question Thirty years later, Barnard reprinted the list in *Knowledge*, but again no observations are recorded

It was to determine the presence and extent of the nebulosity observed by Herschel that, in 1903,

Isaac Roberts undertook a systematic examination of the fifty-two fields Roberts photographed each field simultaneously with his 20 inch reflector and with a 5 inch Cooke lens The result of this survey was given in a paper which appeared in the *Monthly Notices*, *R A S*, vol 63 In this, Isaac Roberts reported that in four of the regions only had his photographs confirmed Herschel's observations In the other forty eight regions no trace of nebulosity was shown on his plates In recording this he was reporting the result of a survey taken on a definitely determined plan laid down beforehand The exposure time given to both series of photographs was ninety minutes, this being considered sufficient to show any nebulosity likely to have been seen by Herschel It was pointed out at the time that both Max Wolf and Barnard had photographed nebulosities in some of these forty eight areas There the matter rested for a while, until, in 1926-27, Father Hagen published the results of his visual survey, in which he confirmed Herschel's observations

As a tribute to the memory of her husband, Mrs Isaac Roberts now publishes an atlas of the fifty two regions, consisting of sixty plates, reproduced from the original negatives taken by him in the course of his survey The atlas is remarkable for the care which has evidently been taken to ensure a faithful copy of the original plates As photomechanical reproductions of astronomical photographs they are amongst the finest we have seen The atlas, as a whole, is very tastefully got up, and it is an easy matter to make identifications on the plates, full particulars being given on each sheet The plates are reproductions in ' negative,' the stars appearing as dots on a white ground, undoubtedly the best way of reproduction To those interested, this atlas should prove to be one of the greatest value The plates have been reproduced on an enlarged scale of 10 mm =6 3′ for reflector plates and 10 mm =32′ in the case of the 5 inch lens photographs

The text which accompanies the atlas contains a short account of Herschel's observations of the fields, followed by Isaac Roberts' report on the result of his photographic survey A very full and complete description of the charts, accompanied by tables, is also given There is also a chart showing the distribution of the fifty two areas, which are somewhat scattered over the northern hemisphere and extend to 100° N P D In a preface, Father Hagen, Director of the Vatican Observatory, gives a historical account of the observations of these regions of the sky hitherto made

In publishing this series of plates, Mrs Isaac Roberts could not have chosen a more fitting manner of paying tribute to the memory of one who was a pioneer in astronomical photography, and whose work in this direction gained for him the well merited reward of the gold medal of the Royal Astronomical Society The plates now reproduced are further evidence of the skill and devotion with which he applied himself to his task

No doubt many will be glad to know that copies of the atlas may be purchased

Our Bookshelf

Ice Cream a Textbook for Student and Manufacturer By Prof G D Turnbow and L A Raffetto Pp ix+407 (New York John Wiley and Sons, Inc, London Chapman and Hall, Ltd, 1928) 20s net

The making of ice cream has become an important branch of the dairy industry in the United States, and the above volume has been written to serve as a text book for students—instruction in ice cream manufacture is now given in thirty of the State colleges in America—and a reference book for those engaged in the trade

The material in the book is well arranged First a historical introduction, then, after a discussion of the food value of ice cream, three chapters are given to recipes used in making the many different kinds of ice cream which are mentioned, some of them of an elaborate nature The use of fresh fruit and fruit juices plays an important part in these recipes In another chapter the basic materials of ice cream—milk, cream, butter, sugar, gelatine, and eggs—are dealt with, and a number of formulæ by which the proportions of the ingredients for any mixture may be calculated are given Mixing is followed by pasteurisation and after this operation the mixture is homogenised, to break up the fat globules and increase the dispersion of the fat, then comes the freezing of the mixture Complicated machinery is required for the last two operations, and a good account of it is furnished An important chapter is the one dealing with the various engineering questions connected with the running of a modern ice cream plant As dairy products are the main raw material, methods for their analysis are given, as are also methods of bacterial analysis

Although the manufacture of ice cream in Great Britain in no way approximates to the industry in the United States, there are no doubt many to whom this book will appeal, and to them it can be strongly recommended Perhaps in time—and a start has already been made—ice cream will become as popular in England as in America, it is clear that an increase in consumption will be to the benefit of the dairy industry Already there is a demand on a small scale for instruction in ice-cream making, and two at least of our dairy institutes have taken up the subject

Dielectric Phenomena 2 *Electrical Discharges in Liquids* By S Whitehead Edited with a Preface by E B Wedmore (Published for the British Electrical and Allied Industries Research Association, being Reference L/T 30) Pp 137 (London Ernest Benn, Ltd, 1928) 12s 6d net

IN the first volume of this treatise, Mr Whitehead discussed electrical discharges in gases So long ago as 1905, A Russell pointed out (*Proc Phys Soc*, vol 20, p 49) that the maximum stress at which a spark ensued between spherical electrodes immersed in a gas was constant within certain limits In 1910 the same physicist pointed out (*idem*, vol 23, p 86) that an algebraical expression of the form $A + B/\sqrt{a}$, where A and B are constants and a is the radius of either of two cylindrical electrodes, could be used to predict the stress at which ionisation begins in air

Since then, an immense amount of research to discover new laws and to show how the results could be applied to testing commercial materials has been done When the electrodes are in a liquid and the voltage is raised sufficiently, an unstable rise in the small conduction current takes place at a definite voltage This may discharge the electrodes or may result in the formation of an arc This phenomenon the author terms 'spark over in liquids' Previous to its occurrence, transient flashes sometimes pass between the electrodes, or streamers may spread out into the gap In rare cases a glow may be observed previous to the sparkover, somewhat similar to the corona we see in air In most cases the electric strength of a liquid depends on the impurities in the liquid, and hence a distinction has to be made between the electric strength of the pure liquid and the liquid in the commercial state The author states that theories put forward to explain the variation in the electric strength of liquids generally discuss merely the behaviour of the impurities It appears that to get formulæ for the electric strength in these cases both the effective and the maximum potential difference have to be taken into account

Organic Syntheses an Annual Publication of Satisfactory Methods for the Preparation of Organic Chemicals Roger Adams, Editor in Chief Vol 8 Pp vii + 141 (New York John Wiley and Sons, Inc, London Chapman and Hall, Ltd, 1928) 10s net

THE editors direct attention to two distinct processes for making both β-chloropropionic acid (from acrolein or trimethylene chlorohydrin) and trimethylacetic acid (from *tert* butyl chloride or pinacolone) One of the most interesting of the preparations included in the volume is that of *l* arabinose from mesquite gum This material, which is collected by the natives in the south-western United States and northern Mexico, is stated to furnish from 36 to 46 per cent of its weight of crude *l* arabinose, and a yield of 25 4 per cent of the purified sugar is mentioned in the preparation described The raw material is said to be abundant, the process is simple, and the yields are comparatively high A detailed description of Prof Roger Adams's apparatus for the catalytic hydrogenation of organic compounds is another feature of this volume which merits particular mention, for a working account of a really dependable apparatus of this type has long been needed Prof Adams's hydrogenator is simple in construction, and the reviewer gladly avails himself of this opportunity of testifying to its effective working in actual laboratory practice J R

Fluorescenz und Phosphorescenz im Lichte der neueren Atomtheorie Von Peter Pringsheim (Struktur der Materie in Einzeldarstellungen, herausgegeben von M Born und J Franck, Band 6) Dritte Auflage Pp vii + 357 (Berlin Julius Springer, 1928) 24 gold marks

THE first edition of Prof Pringsheim's book appeared in 1921, and it consisted of just over two hundred pages The preface to the third edition is dated Christmas 1927, and this edition consists of more than three hundred and fifty pages Yet it is clear that the author must have used considerable restraint in order to keep the new edition within these bounds, when we remember the large amount of important work which has been published during the interval between 1921 and 1927 For example, we have the important work of Cario and his collaborators on the phenomena produced by collisions of the second kind, and researches, such as those of Wood and Ellett, on the polarisation of resonance radiation

Prof Pringsheim carefully describes all these new advances, and his book is a very useful guide to the whole subject of fluorescence and phosphorescence The subject is a very large one, which is continually growing at a rapid rate, and it is interesting to remember that the recent work on the newly discovered Raman effect must already have provided sufficient material to encourage Prof Pringsheim to look forward to the appearance of a fourth edition of his book

Manuel de photographie Par H Vial (Bibliothèque professionnelle) Pp viii + 276 (Paris J B Baillière et fils, 1928) 16 francs

THE pages are not very large, nor are they exceedingly numerous, but M Vial has justified the title of 'Manual of Photography" by giving the essence of each subject described, and avoiding such matter as belongs more properly to trade lists and circulars The treatment is quite modern, including desensitising, sensitometry, enlarging, bromoil, ozobrome, photography of coloured objects, photography in colours (autochrome), and stereoscopic work The subject is divided into four parts (1) General and introductory, including elementary optics, objectives, perspective, and apparatus, (2) the negative, (3) the print, and (4) sundry matters mentioned above, and the use of artificial light The illustrations are all helpful and nearly all are original, and the practical directions are sufficient in the more important sections

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Cameroon Gorilla.

IN NATURE of Dec. 24, 1927, Sir Arthur Keith discussed a collection of gorilla skulls which I made in the Mamfe district of the Cameroon. German authorities had long separated this western race from the better known Congo gorilla and had given the Cameroon gorilla the title of *Gorilla gorilla diehli*. Yet no skin of this new species has yet been described, and so great an authority as the director of the Berlin Zoological Museum has even doubted if the species still exists.

Two skins have recently come into my possession from the heart of the Mamfe area, one of which is a mature female, while the other is alleged to be her offspring and is a female of two or three years. In each case the skull was tied to the skin.

The coat of the infant is entirely black except for a patch of brown hair between the ears stretching five inches back from the forehead. There are however, a few sparse white hairs on the back, but not enough to render it in any sense grey. It differs from the chimpanzee of the same age in this neighbourhood in that the hair is shorter and coarser. The older female, which is probably the mother, has a coat which is quite black on the flanks and belly, but quite grey on the back except for a patch of brown six inches long above the forehead.

The hirsute appearance is, therefore, in no respect different from the gorilla of the Ubangie district of the Congo, several fresh specimens of which I was privileged to see last year in Major Powell Cotton's magnificent collection. Nor is there any single feature of the skull which is peculiar to this new species.

It is, therefore, open to question whether it is proper to erect a new species or even subspecies on such slender grounds, since such differences as can be shown to exist may well be racial.

The really striking differences between the Cameroon gorilla and his fellow at the eastern extremity of the gorilla belt are those of habit and behaviour. For whereas Carl Akeley and others have described the eastern gorilla as timid and retiring, the Mamfe gorilla is excessively ferocious and neither timid nor shy. Alone among wild animals with which I am acquainted, the adult male gorilla will *always* attack man on sight. This profound alteration in his behaviour as he approaches the western limits of his range might perhaps justify the creation of a new subspecies which could not be justified on anatomical grounds alone.

Akeley's gorilla differed in another important respect from his western prototype, in that he always slept with his female belongings in trees. So far as I am aware, and I have slept among them several times, and as lately as last week, this is never the case with the Cameroon gorilla, among whom the great male will invariably make his bed on the ground at the base of the tree in full view of his females and offspring in their tree beds.

This observation of mine has been held to be original and scarcely authentic, but on reference to the literature on the subject I find that H. von Koppenfels more than fifty years ago made the same observation in reference to gorilla inhabiting the country that lies between the mouth of the Muni River and that of the Congo.

The point I am anxious to emphasise is this: that if wide differences in habits and behaviour can give grounds for the creation of a separate species, then the Cameroon gorilla may fairly claim that distinction. If, however, a new species must show some definite and constant physical variation either in the bones or the hirsute appearance, it is impossible to separate the most easterly gorilla, that from Kivu, from those I have studied in the extreme west in the Cameroon and Nigeria. Such differences as exist are racial and not specific.

N. A. DYCE SHARP.

Ogoja, Nigeria,
Jan. 21.

Line Absorption Spectra in Solids at Low Temperatures in the Visible and Ultra-violet Regions of the Spectrum.

FROM extrapolation of X-ray data, it is known that the electrons in the N_1 (and N_2) shell of the ions of the rare earths possess *less* energy than those in the O shells. Expressed in terms of the Bohr-Stoner scheme, the electrons in the 4_4 shell are held less tightly than those of the 5_1 or 5_2 etc. shells. According to that scheme the electrons are arranged in the following manner:

Atomic Number of the Neutral Atom	Symbol of Ion	$1_1 \longleftrightarrow 4_3$	4_4	5_1	5_2
57	La^{+++}	closed shells	0	2	6
58	Ce^{+++}		1	2	6
59	Pr^{+++}		2	2	6
71	Lu^{+++}	,,	14	2	6

The proof that the 4_4 shell is gradually filled in this way was completely established by Hund (*Zeit. fur Physik*, **33**, p. 855; 1926). By assuming the above arrangement and the presence of *normal* multiplet coupling between the orbital and spin moments of the electrons, he calculated the character of the most stable energy level for each ion and its corresponding magnetic moment just as if the ion were in the gaseous state. His results were in beautiful accord with the magnetic data on the solids and on their solutions—with but two exceptions.

Similar calculations for the ions of the iron group failed of agreement as might have been expected, since chromic ion, for example, in solution is the molecular ion $Cr(H_2O)_6^{+++}$ due to the water of *co-ordination* and not the atomic ion Cr^{+++} (*Jour. Amer. Chem. Soc.*, **49**, p. 2456; 1927).

Such extraordinary immunity from external coupling as is exhibited by the ions of the rare earths in their magnetic behaviour suggested that their absorption spectra might resemble the line spectra of ions in the gaseous state. The basic electronic level in each case would be, then, the one confirmed by Hund from its magnetic moment.

X-ray data lead to the conclusion that the energy necessary to remove a 4_4 electron completely from its ion is probably within the range of a quartz spectrograph. Indeed, most of the salts are coloured, so that the energies required for electronic activation may be measured through glass. We used a large quartz spectrograph from Hilger and a three prism 'Uviol' glass spectrograph from Steinheil.

Of previous investigations which concern us here, those of Becquerel alone in 1906, in collaboration with Kamerlingh Onnes in 1908, and finally with Kamerlingh Onnes and de Haas in 1925, are the most important. (See the remarkable summary by J. Becquerel in "Gedenkboek aan H. Kamerlingh Onnes," 1922, p. 288.) They studied the absorption spectra of minerals principally, which contained mixtures of rare earth salts, and found that upon lowering the temperature the narrow bands appearing at room temperature

became much narrower, and in some instances attained a sharpness comparable with the line spectra of gases However, they made no recorded attempt to identify their spectra or to evaluate them Their measurements were limited on the short wave length side of the spectrum by the glass (Dewar tubes) which enclosed their crystals

We have begun a systematic study of the absorption spectra of the individual rare earths from room temperature to that of liquid hydrogen, both in the visible and in the ultra violet At present we wish to report the general features of the spectra already obtained, those of gadolinium, samarium, and erbium

Gadolinium —The uniaxial crystal of $GdCl_3\ 6H_2O$ was made from $Gd_2(SO_4)_3\ 8H_2O$ of atomic weight purity prepared under the direction of Prof B S Hopkins of the University of Illinois, to whom we are extremely grateful The spectra were practically identical with that obtained from a crystal from another source The spectrum consisted of about sixty lines similar in sharpness even at room temperature to the emission lines of iron which were used for comparison At room temperature the entire spectrum was in the ultra violet extending to about 2350 A Upon lowering the temperature new faint lines appeared in the visible, and most of the old lines shifted slightly toward the red There was but little change in the spectrum between the temperature of liquid air and that of liquid hydrogen

The substitution of bromide for chloride did not affect the general appearance of the spectrum, but it separated the components of the multiplets a little, displacing some components toward the short and some toward the long wave lengths

From the magnetic moment of gadolinium ion we know that the level lowest in energy is an ^8S term, and by the Hund theory the other basic levels belong to systems of lower and even multiplicity Groups of lines allow themselves easily to be arranged as multiplets in energy diagrams Many of the closely spaced lines appear to have originated by the splitting up of a 'normal' energy level because of the influence of the electrostatic fields of the neighbours of the gadolinium ions, principally by the water molecules We are led to this conclusion by the small change induced by the bromide ion The fact that it displaces the lines in particular groups both toward the short and toward the long wave length regions practically decides that the Stark levels are shifted above and below the 'original undisplaced' energy level

Samarium —$SmCl_3\ 6H_2O$ was prepared from a salt of samarium of unusual purity kindly furnished us by the late Prof C James, of New Hampshire College At room temperature its spectrum consisted of diffuse lines and bands mostly in the region between 3000 A and 5000 A Upon lowering the temperature the lines sharpened and the bands became narrower At the temperature of liquid hydrogen the lines were exceedingly fine, and the uneven intensity of the few remaining bands suggested a complete resolution into lines if the temperature were further reduced At the low temperatures some lines disappeared and new lines, all extremely sharp, made their appearance The appearance of a new spectrum and its increasing prominence, at the lower temperatures, confirmed the expectations derived from magnetic measurements about to be published by one of us They show that samarium ion in the solid state is a mixture of electronic isomers A considerable proportion of the samarium ion (the ratio varying with the temperature) is present in each of two distinct electronic levels differing very little in energy

The spectrum which disappears as the temperature is lowered is due to the thermally excited state, and the new sharp lines which become more intense as the temperature is reduced reveal the presence of the ion that is more stable at the lowest temperatures

Erbium —$ErCl_3\ 6H_2O$ was recrystallised several times from an erbium salt marked pure by the Welsbach Company Its spectrum at room temperature consisted of very diffuse bands, but at the temperature of liquid air, and especially at that of liquid hydrogen, the bands became resolved into lines of extraordinary sharpness These lines clustered in groups, and the latter were separated by rather large intervals The structure of the groups did not suggest band spectra of gaseous molecules, but rather the multiplets of gaseous atoms under the influence of external fields Very few lines were found below 3000 A

We are extending this work to include the other rare earths and are studying especially the influence of other negative ions and of water of crystallisation on the various spectra This work promises quantitative information concerning such influences of far greater sensitivity and accuracy than can possibly be obtained by the use of the double X ray spectrometer with which many similar investigations are being undertaken

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Knock Ratings of Pure Hydrocarbons

Messrs Birch and Stansfield have been good enough to send us a copy of their letter in reply to our communication which appeared in Nature of Feb 23 Our remarks on the knock rating of pseudo cumene are taken from the Aeronautical Research Committee Report and Memorandum No 1013 (1925), in which it is stated that the addition of 5 per cent by volume of this hydrocarbon to a common No 1 petrol lowers the H U C R of the latter to the extent of 0 4 per cent, whereas the addition of the same amount of benzene raises the H U C R by 1 0 per cent

With regard to the figures quoted by Mr Birch and Mr Stansfield for trimethyl ethylene and diamylene which do not agree with our own, it will be observed that our figures refer to concentrations by volume, whereas theirs refer to concentrations by weight Therefore, the two sets of figures do not allow of strict comparison, because relations between concentration and anti knock value are often not linear and because of the comparatively large difference in the specific gravities of the two hydrocarbons concerned

The observation that an acid refined unsaturated spirit has a lower anti knock value than the original is readily explained by the fact that quantitative conversion of olefines to polymers is never attained in ordinary refining practice Especially is this the case with the butylenes, amylenes, and hexenes, the hydrocarbons in question, in fact these substances are largely removed by the acid in the form of sulphuric esters Many references have been made of late in the American scientific press to the relative merits of the various methods of anti knock engine testing commonly used, and it has often been observed that exact correlation of the results obtained by different methods is frequently difficult to obtain (Edgar, *J Soc Aut Eng*, **22**, 1, 41, 1928 MacCoull, *Oil and Gas J*, May 10, 1928, p 208) Edgar has pointed out that the apparent discrepancies are probably due to the different fuel air ratios employed It will be apparent that the addition of 20 per cent of such a volatile substance as trimethyl ethylene (B P

38 42° C) will raise the volatility of any spirit in which it is dissolved to a quite appreciable extent, and, because of this, the strength of the explosive mixture reaching the engine cylinder will be considerably altered unless precautions are taken to prevent this or unless the air fuel ratio is standardised in some way

It is highly probable that the difference between our figures for trimethyl ethylene and diamylene and those quoted by Mr Birch and Mr Stansfield is due to such an effect Suffice it to say that in our determinations with the Delco testing unit fitted with the Midgley and Boyd bouncing pin the technique adopted was the same as that used by the Anglo American Oil Co and its associated American interests, and embodied the important recommendations on mixture strength recently made by Campbell, Lovell, and Boyd (*J I E C* **20**, 1045, 1928) The samples of trimethylene and diamylene we used for the engine tests possessed the following properties, which show good agreement with those recorded in the literature

Diamylene	B P 150 156° C
	$D\frac{20°}{4°}$ 8112
Trimethyl ethylene	B P 38 3–38 5° C
	$D\frac{15°}{4°}$ 6669
	$N\frac{15°}{D}$ 1 3910

We agree with the necessity of ensuring that all hydrocarbons are free from peroxides before conducting engine tests owing to their extreme action in promoting detonation (Callendar, *Engineering*, pp 147, 182, 210 1927, Mardles, *J C S*, p 872, April 1928)

We are very interested in the observations of Mr Birch and Mr Stansfield on the auto oxidation of cyclohexene We have observed that cyclohexene possesses a greater affinity for gaseous oxygen than the straight chain olefines (cf Stephens, *J A C S*, **50**, 568, 1928), nevertheless pentene 2 and trimethyl ethylene as well as cyclohexene both decolorise indigo solution and liberate iodine from aqueous hydriodic acid and feebly acidified potassium iodide after exposure to ordinary light and air for a few days Refluxing the hydrocarbons over sodium for some hours destroyed this action, but products of auto oxidation were again detected after a short exposure to ultra violet light Oxidation products such as peroxides and aldehydes have been detected in a cracked spirit long before any formation of gum or any discoloration has been apparent

We have also observed that the two olefines di isobutylene and diamylene react with gaseous oxygen under the action of light much more slowly than do the simple olefines such as the pentenes, while pseudo cumene and m xylene, aromatic hydrocarbons which have not the anti knock properties of toluene, suffer auto oxidation very quickly It therefore appears that in the olefine series, and perhaps in the aromatic series also, ease of oxidation is intimately connected with anti knock action, and in this connexion the phenomenon of auto oxidation is especially interesting, having in mind the results of experiments recorded by Callendar (loc cit) This investigator has shown that peroxides and aldehydes are products of incipient oxidation during the compression stroke of an internal combustion engine, and that the extent of such oxidation is an important factor in the knock rating of any fuel Messrs Birch and Stansfield's views about the compactness of the molecule among isomerides on knock rating are clearly complicated by their remarks on the behaviour of certain members of the aromatic series We feel that insufficient work on this subject has yet been published upon which to base such a generalisation which will apply to hydrocarbons of all types

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The Boundary of the Solar Chromosphere

IN connexion with the theoretical side of the question discussed by Mr R W Gurney (NATURE, Feb 16, p 240) and further by Prof F J M Stratton and Mr C R Davidson (NATURE, Mar 2, p 318) the following points may be of interest

In a paper shortly to appear (*Monthly Notices, Roy Astr Soc*, March) I have tried to interpret the recent published measurements of the hydrogen chromosphere At present it is only possible to give orders of magnitude However, putting together the observations of Davidson and Stratton (*Mem Roy Astr Soc*, **64**, 105, 1927) and Davidson, Minnaert, Ornstein, and Stratton (*Monthly Notices, Roy Astr Soc*, **88**, 536, 1928), on the Balmer series and associated continuous spectrum, with those of Pannekoek and Minnaert (*Verh d Kon Akad Amsterdam*, **13**, No 5, 1928) on the absolute intensity of the H_γ line, one concludes that at the base of the chromosphere there are about $2\ 2 \times 10^{10}$ ionised atoms of hydrogen and about 6200 atoms in the Balmer state, per cm^3 (Stress is not to be laid on the precise number 2 2, which is only an estimate of the order so far as it can be derived from the present state of observation and theory) Now, *were* there thermodynamic equilibrium these two numbers would be characteristic of ionisation at almost exactly 5000° K

The chromosphere is not in thermodynamic equilibrium, but I give reasons (loc cit and *Proc Camb Phil Soc*, **24**, 506, 1928) which I believe show that the various properties atomic motion, distribution among stationary states, degree of ionisation, all define temperature parameters of the same order, say, to give rather wide limits, 4000° to 6000°, which is also the order of the temperature of the incident solar radiation This agrees with the above numbers

I venture to suggest that these considerations explain why chromospheric Ca^+ at the low pressures given by Prof Milne's theory is not largely ionised to Ca^{++} Milne explains it by the removal by gravity of the Ca^{++} ions as soon as they are formed, but I believe it is due to the fact that the large excess of hydrogen ions and electrons gives the Ca^{++} ion a vastly increased chance of recapturing an electron I find that if the Ca^+ were in equilibrium at 5000° with these $2\ 2 \times 10^{10}$ free electrons per cm^3 it would be only 4 7 per cent ionised, and I conclude that the order of ionisation must be the same in actual chromospheric conditions

So long, therefore, as the hydrogen provides enough electrons to keep the ionisation of the Ca^+ fairly low, I conclude the type of equilibrium of the calcium is that given by Milne's theory But as we ascend in the chromosphere and the number of electrons decreases we expect a departure from this type to set in until, at sufficient heights, the increased ionisation prevents it holding any longer The radiation pressure on the calcium presumably then becomes negligible

These considerations support Mr Gurney's view that there must be a sharper upper boundary to the calcium atmosphere than former theory predicted They show, however, that ionisation, and not, as he tentatively suggests, the 'coefficient of partial support,' is probably the determining factor

Unfortunately, one cannot discuss the height of the

Ca^+ layer, since one does not yet know the density law of the ionised hydrogen. Pannekoek and Minnaert's work indicates it only so far as 3000 km approximately, and precludes extrapolation by suggesting that their empirical law for H_γ ceases to be valid at that height.

This work, too, it may be mentioned, gives a fairly rapid falling off of the hydrogen line intensities with increasing height in agreement with Mr. Gurney.

I attempt a discussion of the equilibrium of the hydrogen in my paper, but reach no positive conclusion.

W. H. McCREA.

Göttingen, Mar. 5.

Insects Flying to Ships.

ALL those who have travelled about the world in recent years must have noticed the insects which fly to ships at anchor, attracted by the bright electric lights. Some years ago I secured a most interesting series (including a new species of moth) off the coasts of Chile and Peru, and in many other places have made collections where I could not go ashore. The most remarkable occasion of this sort was perhaps at Diamond Harbour, on the Hooghly River, near Calcutta, in December 1927. Going up, we waited some time, and again going down (on the way to Rangoon). The latter delay was caused by a railway accident in France, which prevented the through mails from arriving in time, so we had to wait until they were brought out in a tender some time in the night. Thus the deplorable accident brought good fortune to an entomologist travelling in India—a curious example of the interdependence of things. Diamond Harbour is not really a harbour but merely a station on the river where ships anchor to await favourable conditions, with the shore distant perhaps half a mile.

The insects which came on board at Diamond Harbour were of various orders, but I will now only enumerate the remarkable series of Carabidæ or ground beetles, and a few beetles of other families, all identified for me through the kindness of the Imperial Bureau of Entomology. The Carabidæ were determined by Mr. H. E. Andrewes, the well known authority on this group.

CARABIDÆ.

Casnoidea cyanocephala Fb.
**Clivina tranquebarica* Bon.
**Tachys impressipennis* Mots.
Tachys unistriatus Putz.
Apotomus hirsutus Bates.
**Oodes westermanni* Laf.
**Diplocheila impressa* Fb.
**Diplocheila polita* Fb.
Liodaphus birmanus Bates.
**Anoplogenius microgonus* Bates.
Anoplogenius new species.
**Stenolophus smaragdulus* var. *quinquepustulatus* Wied.

Andrewes has just published a long list of the Carabidæ of Ceylon, which includes, of the above list, those marked by an asterisk. Will some of the others presently reach there on ship board, and is it possible that some already noted in both lists were carried to one or the other place on ships? Three of the above genera are at present apparently absent from Ceylon.

Some other beetles represented at Diamond Harbour were:

Cicindelidæ. *Cicindela sexpunctata* Fb.
Staphylinidæ. *Pæderus fuscipes* Curtis; *Philonthus quisquiliarius* var. *inquinatus* Steph.
Mycetophagidæ. *Litargus varius* Grouv.
Donaciidæ. *Donacia delesserti* Guér.
Haltioidæ. *Chætocnema concinnipennis* Baly.
Hispidæ. *Hispa armigera* Ol.

It is a remarkable fact that both the species of Staphylinidæ cited also occur in Britain, and *Pæderus fuscipes* also flew on to the ship when we were anchored off Sourabaya, Java, on Mar. 7. Who can doubt that these have been spread by shipping?

We have in recent years heard a great deal about the spread of insects by automobiles, but perhaps we have not always appreciated the important part which must be played by ships, now that the vessels are so large, and carry so many electric lights. I suggest that travellers, even if not entomologists, might frequently do a good service by collecting the insects coming on board, especially the beetles, which need only to be put in a small bottle of alcohol. A more ambitious but interesting project would be to take out a small vessel with a bright light and determine just how far from the shore insects of different kinds can be attracted.

T. D. A. COCKERELL.

University of Colorado,
Boulder, Jan. 29.

Fine Structure Absorption Edges in Metals.

IT is well known from the experiments of Lindh and others that when pure metals are examined, in general no fine structure edges (as distinguished from the secondary absorption edges) are observed. If, as is generally believed after Kossel, the fine structure edges originate in the removal of the electron from the K shell to the various optical levels in the atom in question, it is difficult to understand why these edges should be absent in them. The non-appearance of the fine structure edges when metallic plates or metallic crystals (in the form of powders) are used as absorption screens can be explained on the hypothesis of the existence of free electrons in metals. The primary absorption edge originates from the removal of an electron from one stationary orbit inside the atom to another optical orbit, both these orbits possessing definite energy value.

In metallic plates the outermost electron or electrons may be supposed to be free, and as such the optical levels of definite energy values, as are usually observed in the vapours of these metals, can have no real existence. The removal of an electron by the absorption of radiation from the K shell to the periphery of the atom simply sets the electron free from the atom, and unless the former has sufficient energy it will be confined to the metal itself. The extra energy necessary to take the electron out of the metal depends on the nature of the material and the crystal lattice, and is generally of the order of 4.5 volts. Thus not only the fine structure according to Kossel will be absent in metals but also the most intense position of the white absorption will be confined to a range (of about 4.5 volts) smaller than the ionisation potential of the atom in question.

This statement is supported by the works of Fricke (aluminium and magnesium), Lindh (potassium, titanium, vanadium, chromium, manganese, and iron), and Chamberlain (titanium, vanadium, and chromium) in metals. Though we may not have fine structure edges of metal as predicted by Kossel, which should appear only in vapours of these elements, one can surely expect secondary absorption edges of these metals caused by the multiple absorption of the incident radiation by two or more electrons occupying different energy levels of the atom under consideration (see Ray, NATURE, Nov. 17, 1928, p. 771; Lindsay and Voorhees, *Phil. Mag.*, November 1928).

In vanadium metal, Lindh has observed a secondary absorption edge with a separation of 8.7 volts from the primary. Evidently this edge cannot be included under the category of Kossel's fine structure edge,

as the ionisation potential of vanadium is only 6 5 volts A rough calculation shows that this edge originates from the double absorption of the radiation by the electrons in the K and M shells, the energy value of the latter being of the order of 8 9 volts

The case of non metals and solids from this point of view will be discussed separately

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Origin of the Ultra-violet Beryllium Hydride Band Spectrum

THE beryllium arc in a hydrogen atmosphere emits two band systems—one in the green region at 4800 5120 A, and the other one in the ultra violet from $\lambda 3700$ and extending as far as can be reached by quartz optics Very recently both band systems have been measured and analysed by W W Watson (*Phys Rev*, **32**, 600, 1928), and independently of this, M Peterson (*Phys Rev*, **31**, 1130, 1928) has given a short account of the green system Both investigators state that this system belongs to an electronic transition $^2P \rightarrow {}^2S$ of beryllium hydride, thus apparently corresponding to the long set of well known band systems emitted by hydrides of magnesium, calcium, zinc, cadmium, and mercury The ultra violet system was analysed by Watson only in the region $\lambda 3700$ 2700 and thus permits no definite statements regarding the pure electronic transition $n' = n'' = 0$, which falls below $\lambda 2700$ However, as pointed out by Watson, the investigation of the band $n = n'' = 0$ is necessary for information regarding the origin of the ultra violet system Watson hesitates between two alternatives the ultra violet system emitted by beryllium hydride having a common final state with the green system $^2S \rightarrow {}^2S$, or belonging to an ionised BeH^+ molecule, the transition being of the type $^1S \rightarrow {}^1S$

More than a year ago I was engaged upon an investigation of the band spectrum of beryllium oxide (*Arkiv för Mat* etc, Bd 20 A, 1928), and in the course of work was led to study the spectrum of beryllium hydride From this point of view I was interested in the two alternatives mentioned above The ultra violet system was photographed by a Hilger quartz spectrograph E_1 which gives the spectrum completely resolved down to $\lambda 2200$ A large number of bands belonging to the final vibrational state $n'' = 0$ [$0 \rightarrow 0$, $1 \rightarrow 0$, $2 \rightarrow 0$, $3 \rightarrow 0$, $4 \rightarrow 0$], were measured and analysed The values of their final rotational term differences $2\Delta F''$ definitely rule out the first alternative given by Watson Both $2\Delta F'$ and $2\Delta F''$ can be represented by the ordinary formula $2\Delta F = 4Bj + 8Dj$

The $B^{(n)}$ values so obtained are here given

$$2B'_n = 14\ 45 - 0\ 31n',\quad 2B''_n = 21\ 7 - 0\ 62n'',$$
$$(n = \tfrac{1}{2}, \tfrac{3}{2}, \qquad)$$

For the green system the values obtained from the measurements by Watson and myself are

$$2B_n = 20\ 9 - 0\ 65n,\quad 2B''_n = 20\ 5 - 0{\cdot}55n''$$

The differences in the final states of both systems, though small, are very distinct The 0 lines ($\nu_0 = P\tfrac{1}{2}$) best fit the formula

$$\nu_0 = 39417\ 1 + [1476\ 6n' - 14\ 9n'^2 - 0\ 42n'^3] - [2221\ 9n'' - 41\ 3n''^2](n = \tfrac{1}{2}, \tfrac{3}{2}, \qquad)$$

The nuclear separation of the molecule as calculated from B_0'' is $r_0'' = 1\ 31 \times 10^{-8}$ cm

From what is mentioned above I think no objections can be raised to the statement that the known systems are emitted by two different molecules As the only possible origin for the ultra violet bands there remains the ionised BeH^+ molecule This is also in agreement with the fact that the bands are formed by singlet series, the transition being of the type $^1\Sigma - {}^1\Sigma$

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An Optical Method for Analysing Photographs of α-Ray Tracks

FOLLOWING a suggestion from Dr A v Hippel, of the University of Jena, I have tested the following optical method of analysing the right angle views of α ray forks The double camera for photographing α ray tracks is represented diagrammatically in Fig 1

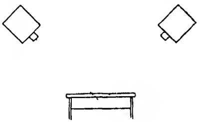
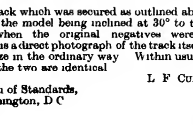


FIG 1

These cameras take two views simultaneously on separate negatives In order to secure a full sized image of the α ray track in the plane in which it occurred, it is only necessary to replace the developed negatives in the camera and project them on the focal plane By adjusting and rotating a thin translucent screen, a position is found where no part of the composite image appears double The screen is then in the proper plane This adjustment is very sensitive, even slight displacements of the screen from the correct position affecting some part of the image

It is very easy to secure a permanent record of the projected image of the α ray track by replacing the screen by a photographic plate A photograph thus obtained is of course actual size and should correctly reproduce all angles of the track in the plane in which they occurred Fig 2 (*a*) shows a photograph of a



(*a*) (*b*)

FIG 2.

model track which was secured as outlined above, the plane of the model being inclined at 30° to the horizontal when the original negatives were made Fig 2 (*b*) is a direct photograph of the track itself taken actual size in the ordinary way Within usual limits of error the two are identical

L F CURTISS

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Solar Diffraction Spectrum from a Single Strand of Cobweb

The following account of an unusual observation of the solar spectrum seems worthy of record in the pages of Nature Recently, in brilliant sunshine, I was taking a country walk, and after walking northwards for a mile or so I turned towards the sun The dark shadow side of a hedge bank was close in front, and at once I saw—through my spectacles clearly projected against the dark bank—a brilliant vertical strip of the solar spectrum Naturally thinking this to be due either to scratches or dust on the glass, I took off my spectacles and was surprised to see a single strand of cobweb stretched horizontally across one lens between the two frame attachments, not touching the glass On replacing the spectacles and raising and lowering the head through a range of about 70° or 80° it was easy to see the first and second orders of the diffraction spectrum, and part of the third The first order appeared, violet uppermost, when the head was raised, the sun being at an angle of about 20° or 30° above the line of direct vision As the head was gradually lowered the second order commenced as a hazy light overlapping the red end of the first order, then the second order blue and green shone out brilliant and pure, and, on further lowering the head, the unusual colours produced by the superposition of the yellow, orange, and red of the second order upon the violet and blue of the third, appeared with remarkable beauty

So far, there is nothing new, for one has often seen diffraction spectra produced by scratches on a window pane, for example in a railway carriage, but the succeeding part of my observation is new to me A sudden brief period of dead stillness allowed the stretched cobweb to stop vibrating in the breeze, and then appeared brightly and definitely (though somewhat out of focus, because, though myopic, my minimum distance of clear vision is 4 or 5 inches) the familiar lines of the solar spectrum, or rather the bright spaces between the lines The strip of spectrum, which had appeared as a rectangle about ten times as long as its breadth, with clean cut edges, now appeared widened by irradiation at every bright space

Being a spectroscopist of some experience I could definitely recognise the 'pattern,' especially in the bright yellow green and in the strongly marked portion of the blue, and, as the observation was several times carefully repeated whenever a dead calm interval occurred, there can be no doubt of its reality On moving the head slightly from side to side I found that the cobweb was evidently finer and more polished in certain parts, and these parts gave a very bright spectrum with very marked alternations of light and dark

Walter Scutt

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Pollination of Species of *Primula*

Darwin (1862) showed that in some species of *Primula*, which are dimorphic (heterostyled), a cross between like forms was less fertile than that between the two forms In other species the heteromorphic and homomorphic crosses are equally fertile

Primula obconica is of the first type, a short styled plant crossed with another short styled plant or a long-styled with a long styled produces no seed, while long styled by short styled and the reciprocal is fully fertile

The following facts suggest that the physiology of the relationship of male gametophyte and style is the key to the situation

Pollen of a long styled plant will not germinate upon a long style of *P obconica* Pollen of a short styled plant will germinate, but the pollen tubes will not penetrate far into the stigmatic tissue of a short style Pollen of either short or long styled plants will produce excellent tubes in the styles of opposite type Upon agar agar and 12 per cent cane sugar medium, pollen of long styled plants only germinates to the extent of 15 per cent, while pollen from short styled plants germinates to the extent of 75 per cent The succeeding growth of pollen tubes of the two types is in accordance with the germination percentages

In *P sinensis*, in which the homomorphic and heteromorphic crosses are equally fertile, the pollen tubes of short and long styled plants grow equally well on both types of style In media there is no observable difference in the behaviour of the two types of pollen

Similar work on other species is proceeding

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The Electronic Charge *e*

In a letter to Nature of March 2, Dr R T Birge has pointed out the difficulty of reconciling the experimental value of 137 2 of $hc/2\pi e^2$ with Prof Eddington s theoretical value of 136 He concludes that it is highly improbable that any of the measurements of the three physical quantities involved could be so much in error The only other possibility seems to be that the value of π we calculate for practically zero field is not the value that should be inserted in obtaining the value of $hc/2\pi e^2$

It is, of course, well known that in a radial gravitational field, the value of π is less than the ordinary value Unfortunately, however, if we imagine that owing to the gravitational attraction of an electron we should use a smaller value of π in calculating $hc/2\pi e^2$ it will only make the discrepancy between experiment and theory worse In any event, the mass of an electron is so small that its effect on the value of π would be completely negligible Is it possible that the intense electric field near the electron could have the reverse effect on the value of π, and thus bring the two values into agreement? This idea may appear rather fantastic, but is perhaps worth some consideration

J H J Poole

Trinity College, Dublin

The British Museum (Natural History)

Many biologists will be grateful for the two weighty leading articles in Nature of Mar 16 and 23, on the British Museum of Natural History and on the Museums of South Kensington This letter does not purpose to discuss the important questions therein raised nor the conclusions drawn, but merely to dispel a possible confusion, which may arise in the mind of the reader of the earlier article, between editorial opinion and the unanimous resolution of the meeting of British zoologists

At that meeting, as the article in Nature of Mar 16 indicates, it was shown clearly that it is the strong and unanimous desire of zoologists that the British Museum of Natural History shall be independent of the British Museum of books and antiquities and on completely equal footing

On the desirability or otherwise of (1) changing the Trustees, (2) coming under a government department, or (3) being ruled by a council of experts, zoological opinion was shown not to be unanimous On these points no resolution was passed. Geo. P Bidder.

Cambridge, Mar 24

Co-operation in Science and Industry[1]

By Prof J F THORPE, C B E, F R S

THE past ten years have witnessed a wonderful development of organised industry and organised science in Great Britain, and although conditions are still rapidly changing it is nevertheless possible to look forward and in some measure to determine the position in which we stand and the prospects for the future The War, although one of the greatest economic disasters the world has yet experienced, gave without question a stimulus to discovery and production which no other event could have occasioned Especially was this the case in the engineering and chemical industries, for the need of new appliances and methods, and the necessity for producing in large quantities and in the shortest possible time, caused the keenest intellects to be brought to bear on the problems at hand, and led to the discovery of new and important processes many of which have now been introduced into industry

It is a principle conceded now even by the enlightened leaders of labour that the universal demand for a higher standard of living necessitates a general increase in the national productive capacity, the term 'productive capacity' being used to mean the capacity to render available the potential wealth of the nation in a suitable form It is chiefly to the chemical and allied industries, mining, metallurgy, etc, that Great Britain turns, because it is their peculiar function, aided by the engineer, to make available its mineral, vegetable, animal, and atmospheric wealth Provided chemical and allied industries are properly organised, they should be in a particularly strong position not only to increase the availability of wealth, but also to guide national policy in questions strongly affecting material prosperity The age is at hand, if it is not already here, in which the changing majorities of governments will no longer be able to determine major policies as of war, financial and fiscal, except in directions approved by organised industry Control by those who hold the keys of national prosperity, that is, of organised industry, is one of the alternatives to class control and is not only a desirable but also an eminently practicable ideal To achieve it science and industry must organise so that they may become strong politically and financially

Four kinds of co operation are essential to strength (1) internal co-operation, (2) co operation with pure science, (3) co operation with Government, (4) co operation with labour The last, that is co operation with labour, is a human question rather than one of science or of policy dependent on science and need not be further discussed, especially since enlightened opinion on the part of employers now realises that labour relations are as vital to prosperity as any other factor

[1] From the presidential address delivered at the annual general meeting of the Chemical Society on Mar 21

INTERNAL CO OPERATION

Apart from more purely chemical or scientific factors, there are two immediate advantages to be gained by the formation of big combines, in the pooling of capital and the pooling of engineering resources, the establishment of a balance in commodities produced and in the method used for their production being determined mainly by chemical and engineering conditions

The standardisation of methods and the co-ordination of interests as regards production and distribution, the question of price and the prevention of over production are problems which mainly concern the business organisation of industry, and do not directly affect the relations between industry and science Yet their importance is manifest, and in some instances, especially in connexion with the standardisation of methods, the help of the chemist is essential The need for obtaining a balance in all these factors, a consummation which can only be reached by a pooling of like interests, is obvious

Probably the best example of the common use of a chemical substance by a number of different manufacturers is that of hydrogen, which is at the present time used in vast quantities for the production of (a) methyl alcohol, (b) liquid fuels from coal, (c) ammonia, to mention three of its most recent applications In pre War days it was used in large quantities, and still is so used, for the hardening of fat Nevertheless, the three industrial operations mentioned also represent in a remarkable degree examples of progress and development that have taken place within the last ten years

At the present time we know nothing of the reasons which determine the action of a catalyst, and although we have to hand a vast number of reactions which may be regarded as reasonable and likely to occur should the right conditions be discovered, the search for a catalyst is always attended with difficulty and often ends in disappointment Prior to the original German patent for the production of methyl alcohol from carbon monoxide and hydrogen, many attempts had been made to realise this very simple reaction even on the laboratory scale

Other reactions readily suggest themselves, such as, for example, the formation of acetic acid from methane and carbon dioxide As a matter of fact, this, and other reactions of a similar type, forms the subject of patent specifications, but whether they have been actually realised experimentally must remain an open question in the absence of definite evidence Our patent system unfortunately lends itself admirably to the production of 'blocking' patents, and there is no subject so suitable as organic chemistry as a medium for such patents

Co operation with Pure Science

Training—Chemical trade is at present in the midst of the most rapid expansion it has ever known and nowhere is the development more noticeable than on the research side This is as it should be, for the researchers are the scouts and it is essential that they should be far ahead of the army (the working process) It is necessary also that the scouts should operate on a broad front in order that no channel of advance should be over looked merely because it does not lie in the ex pected direction The realisation of this principle by the greater manufacturers has led to a strong demand for university trained men, and the number of research chemists in industry in Great Britain has been estimated at twenty times the number before the War, the demand is still increasing The universities have had and are having difficulty in supplying this larger number of adequately trained men, for they have to fulfil the majority if not all the demands made by chemical industry Manufacturers have come to realise that training should be essentially fundamental and that a wide knowledge of the principles of chemical science is a necessity The vexed question in what manner is this to be attained is being answered by the gradual adoption of at least a four years' course, although the still more important one—that of the post graduate course—is not yet settled

A long experience of university teaching has shown me that it is exceedingly difficult to deter mine whether any particular individual is more fitted to succeed as a process chemist or whether he has that peculiar aptitude which will enable him to carry out effective work in the research laboratory Unfortunately, the positions are not interchangeable A student who has shown apti tude for research may, if occasion demands, make an excellent process chemist, indeed it often hap pens that he will have to elaborate a laboratory method so as to place it, with the help of the engineer, on the unit factory scale But it is very doubtful if the individual who has shown that he possesses no aptitude for research can be usefully employed in that connexion excepting under con trol The only manner in which the presence of the research aptitude can be discovered is by direct trial, and therefore it is always desirable to subject a student to one year's training in research after graduation in order to discover if he possesses this characteristic

The term research training' must be interpreted in its widest sense to include training in special branches of chemistry related to the industries as well as more general training in the higher branches of chemical technology

Industrial Research in Universities—At no far distant period in the past the great potentiality for research residing in our university laboratories, and in the personnel controlling them, was not available for industrial purposes The reasons for this were many For example, industrial research was not regarded as of sufficiently ' pure ' character to allow of its inclusion in the academic curriculum There was considered to be something essentially different between ' applied ' and ' pure ' chemistry, and this was emphasised in the 'eighties by the formation of the Society of Chemical Industry as a distinct body from the Chemical Society The Americans knew better than this They have kept their chemists together as a homogeneous body, and the American Chemical Society with its mem bership of 17,000 represents in no uncertain manner the considered opinion of the whole body of chemists of that country

The fault lay mainly with the universities of Great Britain, which were loath to introduce science other than ' pure ' into their courses of instruction Hence there arose the multitude of technical schools which were originally intended to supply the need for a vocational training without undue reference to the science upon which the training was based The establishment of new universities in industrial centres, a period of reform ushered in by the breaking up of the old Federated Victoria University, soon produced a marked change, and research and instruction in the fundamental principles underlying industrial science gradually passed into the hands most competent to deal with them

Industrial research both of the fundamental kind as well as that which arises as the daily outcome of works practice should be and now is carried out for the most part by the firms themselves in their works laboratories But there are a number of problems, mainly of a ' long sighted ' character, which are intimately related to industry The personnel on the scientific staffs of the universities of Great Britain are people who have throughout their lives specialised in some particular branch of research, and are therefore eminently fitted to solve problems in their special field This is now recognised by many leading firms who supply grants to enable post graduate research workers to investigate specific problems under the guidance of professors of chemistry and other directors of research laboratories, and in this connexion must be mentioned the far sighted policy of Imperial Chemical Industries, Ltd, which gives yearly substantial grants to research laboratories in order to enable them to obtain special types of apparatus and appliances which it would otherwise be difficult to procure

Great advances in the development of scientific industry have been made in Great Britain since the War, and every effort must be made to maintain and strengthen the causes which have led to this condition From the point of view of national prosperity it is essential that active research centres should be maintained and still further developed in our universities, not only to supply the scientific ability to foster and improve the industries of our own generation, but also to pave the way by discoveries in science for future commercial prosperity

Team Work—During the War very valuable work was accomplished by means of team work, by which is meant the solution of some problem by the united efforts of a team of workers under a directing head There can be no question that this

method of attack is usually most effective, especially in a works laboratory where some specific problem may require rapid solution. Its application to the university laboratory is subject to the difficulty that under team conditions the intellectual stimulus which attaches to the individual attack on specific problems is sometimes lacking, and it is in the highest degree desirable that this stimulus should be developed and maintained. Nevertheless, it is always possible so to divide a major problem as to make each section in itself a self contained research and thus to give each investigator what is essentially a definite subject on which he can work in his own way and according to his own mentality.

CO OPERATION WITH GOVERNMENT

The Government of Great Britain has already discovered the two most valuable ways in which it can co operate to the benefit of present and future chemical industry, namely, (a) by protecting young and struggling industries against competition from similar but established industries abroad and against competition arising from deflated foreign currency, and (b) by promoting research in pure and applied chemistry by financial assistance. Another way in which it has helped the application of science is by the provision of a free chemical advisory service in the interests of agriculture.

Research Associations —There can be no question that the value of co operative research in industry has been established. The Department of Scientific and Industrial Research has, therefore, rendered a valuable service to the industrial community and its initial policy has been fully justified. Nevertheless, the time has arrived when the varying appeal which the necessity for scientific investigation makes to different industries has made itself manifest, and the Department feels that any further support on general lines would no longer be justified. It proposes, therefore, to treat each case on its merits.

Research Studentships and Fellowships —The call for adequately trained research workers in science, and especially in chemistry, is increasing. It is therefore very disquieting to realise that the policy of the Department in connexion with the provision of maintenance grants for students in training appears to be changing. The outlook is serious, because it is quite impossible for the universities to provide funds for post graduate training in any way commensurate with the present day requirements of industry, and as the average science student is usually drawn from a comparatively poor class, it is not likely that the necessary money for an extended course will always be obtainable from parental sources.

Every director of a research school has had to tell some promising student who wishes to undergo post graduate training and is, without question, likely to profit by such training, that no funds are available to enable him to extend his course and that he must, therefore, seek any minor post that may be open to him. The loss of such a man is a national loss, because his training is broken off at the stage where even one extra year would have enabled him to become a useful member of a research organisation, whereas, in the circumstances, he has to take up some position, probably one involving merely routine work, where the value of his early training will be lost and his initiative and enthusiasm destroyed. It is therefore to be hoped that the diminution in the number of research grants is merely a temporary expedient and that it does not indicate a reversal of a policy which has proved so fruitful during the past twelve years and has shown itself to be an essential part of research development in Great Britain.

The Functions of the Human Skull[1]

By WILFRED TROTTER

THE development of science involves the two processes of collecting facts and of elucidating their relations. In the early days common experience so abounded with unrelated facts that an alert and contemplative mind was an adequate equipment for the man of science and could readily find material for generalisation. Knowledge was like an unexploited gold field, in which the mere attentive wanderer might pick up nuggets of the metal. So were made the earliest discoveries in mathematics, astronomy, and physics. When the surface of the field no longer yielded such finds, the digger with his simple and homely outfit could still from easily accessible deposits gather with his own hand gold dust by the ounce and pound. This was the Golden Age of science; it lasted somewhere about two hundred years, and was nobly marked near its beginning by the "Principia" and near its end by the "Origin of Species". It was the day of the individual digger, of simple apparatus and the still obvious predominance of the worker's mental quality over every accessory circumstance. It was a time in which relatively simple efforts in the collection of facts might have great results. Looking back at it we discern as a characteristic object Wollaston with his laboratory on a tea tray, and as a characteristic incident Hans Christian Oersted noticing in 1819 the deflection of the magnetic needle by an electric current—an experiment it would not be very extravagant to call the most important event of the nineteenth century; or as not less characteristic Joseph Fraunhofer in 1814 observing and thinking it worth while to map out the dark lines in the solar spectrum—a dull looking task that was, however, ultimately to yield a veritable measuring rod for the universe and a most effective probe of even its stupendous depths.

At the present day what we may call the surface

[1] Lecture delivered before the Anthropological Society of University College, London, on Jan. 25.

deposits of truth seem almost everywhere to have been worked over, and ours is the time of the thousand yard shaft, the mile long gallery, the battery of stamps, and the pennyweight yield to the ton The mere collection of facts has become a difficult and elaborate enterprise, to which the solitary worker is rarely equal In almost every branch of science complex equipments are necessary, the mere use of which may need years of training Even genius itself is no longer inspired by the falling apples and spouting kettles of the Golden Age, the powers of Einstein are called out by the quintessential zero of the Michelson Morley experiment, or those of Bohr by the incredible vacancies of the atom

Since the merely observational half of the scientific act has become so formidable, it is natural that the other half that comes of the speculative, contemplative, and relating turn of mind should as such have sunk somewhat in general esteem It is perhaps correct to say that, among scientific people, work of any general speculative kind is a little under suspicion unless it is closely associated with actual observation as well, and that anyone who tries to correlate large groups of facts is unlikely to be listened to with great attention unless he has been concerned at any rate to some extent in the collection of the facts themselves This attitude of the mind is on the whole sound and practical, but it should perhaps be qualified by two small reservations In the first place, the justified predominance of observation may lead to a certain frigidity towards ideas as such, and even some risk of the automatic rejection of them

In the second place, it must be remembered that there are still some few 'alluvial' deposits left unexhausted in the gold field of truth Here the observational side of scientific work may seem when judged by modern standards primitive and 'uneconomic,' and yet it may be capable of yielding appreciable finds One such deposit is the great range of human behaviour, in which we all can be adequately skilled observers and need no more than the critically selective and relating turn of mind Other such opportunities are apt to occur along the line where two fields of observation meet Medicine has many such lines of meeting with the sciences, and its contact with anthropology is one of the most obvious Medical men are interested in the same animal as are anthropologists and have to study it with some intensity

When we study the boundary zone of two adjoining departments of knowledge, we may expect to find what instruction we are to get not so much in learning strictly ordered and documented facts as in getting fresh points of view, we may hope that the well established and matter of course fact or principle from one side of the line may prove new and illuminating when viewed from the other side

In such a study, then, we shall do well not to be too exacting in proof or too systematic in method We must be willing to accept new light where we can find it, and to remember the old paradox that in science the primary duty of ideas is to be useful and interesting even more than to be 'true' We must be ready to entertain ideas freely and fairly, and no less ready to discard them without regret, glad enough when we gain an unexpected glint from "the blank face of familiar things" It will be with very limited pretensions, therefore, that certain considerations derived from surgical experience will be set out here Nothing could be less dogmatic than the spirit in which they are put forward or more submissive to the principle of the aphorism, "Do not believe new ideas, use them"

While the essential object of all biological knowledge is the elucidation of function, the work of the surgeon is actually engaged in the direct study of function in a very special degree He is concerned with the human body solely as a going concern and his unique object is to keep it going In regard to the cranium, he has no direct interest in its size, its form, its types, its indices, he limits himself, with what for the anthropologist must seem a certain crudity, to the question what does it do? In the briefest possible terms, the cranium is to the surgeon the *capsule* and *the skeleton of the brain*

The Capsule of the Brain

It is not usual to regard the brain as among the encapsuled organs, but to do so brings out an interesting aspect of its functional relations with the skull If we consider encapsuled organs in general we at once see that the rigidity of the capsule is an important character In regard to it, organs may be divided into three groups In the first, which may be called the normal type and is represented by the kidney and spleen, the capsule is fully extensible, in the second, represented by the testis, only very slightly extensible, and in the third, represented by the brain and skull, it is absolutely rigid to all physiological forces Such conditions have necessary and very important effects on the mechanics of the circulation in the various organs There is of course a primary need for the flow of blood through any tissue to be continuous, this is effected in organs of the first group by the extensibility of the capsule permitting pulsation and elastic recoil to occur In the case of the brain, however, a different mechanism is necessary The brain itself expands with each arterial pulse, but, as the skull is unyielding, room must be made at each pulsation by the expulsion of a corresponding volume of the low pressure intracranial fluids This is why the veins leaving the skull and the cerebro spinal fluid in the subarachnoid space of the spinal cord show arterial pulsation

The mechanism is adequate, but the margin by which it is so is not very large After violent exertion, when the range of pulsation of the brain is at its widest, we are apt to be conscious of an unpleasant thudding in the head, which shows that the brain can only just find room for its circulatory excursions Again, if one has a slight headache it is at once aggravated by exertion

This circulatory peculiarity is fundamental in cerebral pathology and makes it possible to say

that, apart from purely destructive processes, all cerebral symptoms are of circulatory origin

We may briefly inquire into how this comes about The low pressure outflow that must accompany each arterial pulsation is chiefly in the form of venous blood For it to occur the flow of blood in the veins must be quite free But the pressure in the veins is very low, so that the least abnormal swelling of the brain or part of it causes collapse and obstruction of a greater or less venous territory Thereupon further swelling from venous congestion occurs and the disturbance of function becomes progressive

The brain is thus uniquely sensitive to any pathological change in its bulk When an organ like the kidney is bruised and swells, it matters very little how soon or if ever it gets back to its normal size When the brain has been bruised, it must get back to its normal size or its circulation will remain permanently disturbed A simple bruise of no ultimate importance to an organ with a yielding capsule, is thus a relatively serious matter with the brain The great difficulty with which the brain recovers from even simple injuries that cause swelling is one of the most important functional consequences of its rigid encapsulation by the skull [2]

THE DEFENSIVE FUNCTION OF THE SKULL

It is still a widespread opinion, even to some extent among medical men, that fracture of the skull is the most important feature of head injury, and that if the skull is not fractured not much harm can have been done There is no more complete delusion Fracture of the skull is usually an insignificant element in a head injury, and nothing has done more to limit the knowledge of trustworthy principle than the traditional reverence for it

A fracture means that the skull has been distorted until the limit of its elasticity has been passed It is the distortion, and not the crack that may or may not ensue, that is important

Now surgical experience in Great Britain shows that the skull is susceptible to considerable degrees of distortion by even only moderately severe external violence Because immediate and dramatic effects are not always produced, and because of the superstition about the significance of fracture, it is apt to be assumed that the average European cranium is on the whole very successful in preserving the brain within it from the effects of quite severe violence Since the nature of what are called the minor injuries of the brain has been better understood, this faith in the beneficent fortitude of the skull has been considerably shaken We now know that the skull in its protective function is only moderately effective It is liable to bend under local violence and to permit of a localised bruising of the brain beneath , it is also liable in appropriate circumstances, especially such as falls on the head, to a far more serious general distortion This general distortion causes the very interesting instantaneous and transient paralysis known as concussion of the brain, and is also apt to produce a widespread bruising of the brain substance that is of great practical importance It is important to note that all the evidence points to actual distortion of the skull being the immediate cause of most if not all injuries of the brain There is no reason to suppose that injury is commonly if ever produced by the brain being thrown about inside an undistorted skull It is probably true to say in so many words, no distortion of skull, no injury of the brain [3]

This liability to relatively easy distortion seems to be in some special degree a character of the modern European skull It appears to be fairly clear that in some races the resistiveness is decidedly higher For example, the negro, judged by purely clinical, that is functional considerations, is little liable to receive cerebral contusions from the moderate degrees of violence that an Englishman could not endure with impunity The willingness of the negro to use his head as a battering ram has often been described, and it is said that an experienced policeman will use his truncheon on the head of a negro less hopefully than he would use it on an English head

We arrive then at the position that the modern European skull is demonstrably far from completely effective in its protective function, and that this defect is not shared by all other races

It will be noticed that we are not at all concerned so far with the anatomy of skulls It may or may not be possible to show a difference in the thickness or rigidity of European and negro skulls The test of function is far more delicate and trustworthy than that of structure, and it seems to show that a clear difference exists

We have already seen that the bony capsule of the brain is a serious hindrance to recovery from minor injuries, so that the skull and brain mechanism is satisfactory only when the former is highly effective as a protective covering Once the protective function is impaired the physiological disadvantages of the arrangement become fully manifest It seems clear, then, that the present functional relation of brain and skull—plainly disadvantageous as it is—must be the result of some strong evolutionary tendency or must be accounted for by some advantage that compensates for it

In a very broad and general way, it does appear to be the fact that there has been an evolutionary tendency towards a reduction in the massiveness of the human cranium , there can be no doubt that the modern European cranium is in comparison with many of its predecessors remarkably light and thin It is not improbable, therefore, that a tendency towards the lightening of the cranium is an inherent character of the race and progressive It is natural, therefore, to ask how far such a process could conceivably go The European skull has already discarded a good deal of its protective rigidity , is a rigid cranium a necessary structure ?

[2] It is interesting to notice that the testis—the only other organ in the body that approaches the brain in the rigidity of its capsule—shows the same susceptibility to minor injuries As is well known, it may undergo complete atrophy after a simple bruise

[3] A contrary opinion is perhaps encouraged by the use of the time-honoured and now ineradicable phrases concussion of the brain in English and 'Hirnerschütterung' in German

The Skeletal Function of the Skull

Without considering any other matter but function, this question can be given a perfectly definite answer However much more of its protective massiveness the skull may lose, it must always maintain enough rigidity to preserve its form This is because it is a function of the skull, not the less important for being usually overlooked, to support the brain If we make in the treatment of injury or disease a considerable hole in the skull, and after healing of the scalp is complete the intracranial tension is normal, we find a tendency for the soft parts to sink into the cranial opening This depression is most marked when the subject is standing and usually quite filled up when he is lying down With an opening 3 or 4 in across, the depression may perhaps reach a depth of as much as $1\frac{1}{2}$ in at its centre The larger the opening the greater the depression, and it is clear, therefore, that the exposed brain, when the intracranial tension is at its lowest, cannot support the atmospheric pressure and actually collapses under it In certain cases the subjects of openings in the skull suffer severely from the exaggerated movements of the brain that in them accompany changes of posture Such symptoms are always abolished when the opening is closed by restoration of the skull

In the cranium, in fact, the vertebrate has rediscovered the principle of the external skeleton and exploited it in a remarkably interesting way that may be worth a moment's consideration What may be called the constructional problems of such an immense mass of neural tissue as the brain are very complex The obvious way of supporting a large mass of soft consistence would be the provision of a stiff stroma of ordinary connective tissue Such a solution is inadmissible for very definite reasons In the first place, direct contact between mesoblastic and neural tissues is a physiological impossibility, so that every strand of the hypothetical connective tissue stroma would have to be clothed, as is every cerebral vessel, with a so called 'perivascular lymphatic' to its finest ramifications At a moderate estimate this might double the bulk of the whole organ Again, the presence of an elaborate and alien fibrous network would immensely complicate the system of intercommunication, which is the very essence of the brain as it is How neat a solution of the problem does the exo skeleton provide With it, it is possible for the brain to be made up almost entirely of actual functional elements, and for the utmost complexity of communication to exist while the bulk of the whole organ is kept within bounds

The Meaning of the Vulnerable Skull

We have seen that the low strength of the modern European skull is shown by actual experience to be producing serious effects in the way of a high susceptibility to disabling injuries of the brain To discuss the meaning of this remarkable and perhaps a little disturbing state of affairs it is necessary to enter into some rather general considerations

There can be no doubt that in the growth side by side of the cranium and the brain, the latter is the predominant partner, and what it needs the former must on the whole provide If the skull had no other function whatever but to be the capsule and skeleton of the brain, the correspondence would be absolute and every least developmental variation of the brain would be accurately accommodated by the skull Now the skull or even the cranium does have other functions to fulfil than those concerned with the brain It is involved with the muscles of the trunk, with the apparatus of mastication, with the respiratory tract The provision for these accessory needs must, it seems reasonable to suppose, have some influence however minor on the growth of the cranium, and act as some restraint however minute on the control of it by the brain, and therefore on the freedom of variation of the latter When, therefore the skull is very massive and deeply involved with accessory functions, when it gives attachment to large neck muscles, when it is ridged and fortified for a heavy masticatory apparatus, the freedom of the brain to develop minor variations is perhaps less complete than when the cranium is stripped to the condition of a mere cerebral capsule

Since it is possible that free variability of the brain through a very small range is of value in fitting man for a complex civilisation, it seems not a very extravagant supposition that the freeing of the skull from accessory functions has been a factor in human evolution

Evolution of the Brain and Skull

In considering the evolutionary process in general, then, we have to think not merely of a progressive expansion of the cranium to accommodate the increasing brain, but also of a growing independence of the cranium

It seems obvious that the anterior end of the segmental animal was the inevitable site for the chief nucleus of a centralised nervous system The same region was equally inevitably annexed for the entry to the respiratory and the digestive tracts An interesting series of complications has ensued from this necessary crowding of function into one extremity It does not seem too fantastic to see two tendencies constantly at work and in conflict—the tendency on one hand to make use of the brain skeleton for functions connected with other systems, and on the other the struggle of the brain for autonomy and freedom from these burdens Wherever the former tendency has been definitely the stronger, the progress of the brain has been arrested and the animal has found itself in an evolutionary blind alley The most striking illustration of this process has been in connexion with apparatus of defence and attack Such apparatus has a natural and inevitable localisation near the digestive inlet and at the anterior end of the animal Nature in her experiments with horns, antlers, fangs, and tusks has found the skull waiting as a

convenient foundation for these useful but enslaving structures The ancestors of man, with the steady avoidance of specialisation to which he so largely owes his zoological position, kept their craniums free from such encumbrances

It was, however, probably the beginning of the upright posture that was the decisive change in favour of the independent skull It has not, so far as I know, been much remarked upon that the upright posture changes the whole mechanics of attack and defence from that of the quadruped The head is withdrawn from the front of the animal, and thus being no longer available as a foundation for offensive or defensive structures, the cranium is at last and finally safe from them Another and more familiar way in which the cranium was helped by the upright posture to free itself from accessory functions was in the limitation in the movements of the mandible that necessarily ensued With a poised instead of a slung skull, the mouth can no longer be opened freely enough for the aggressive use of fangs Thereupon the cranium is no longer called upon to find attachment for the correspondingly massive muscles

When we see an evolutionary tendency so strong as that seems to be which has stripped and lightened the cranium until it has reached the degree of fragility and simplification seen in the modern European, we are inclined to ask whether even yet its force is exhausted There are perhaps signs that even now the cranium is, so to say, intolerant even of the light burden of accessory function it still has to bear It is scarcely possible to be familiar with the lower jaw of the modern English without wondering whether the unexhausted tendency we have been considering is not at work to free the cranium even of the temporal muscle It is clear that the molar region of the mandible is shrinking, and experience already suggests that 8 fully erupted molar teeth are nearer the actual normal than 12 Since the temporal muscle is especially concerned with the use of the molars, it is perhaps permissible to wonder whether it, rather than the jaw, is not the real object of evolutionary attack

The tenuity of much of the foregoing speculation must be obvious The argument, however, makes no attempt to be rigorous, and is intended to be illustrative rather than demonstrative The object of it has been to find out whether the old fashioned method of general qualitative survey might not in so favourable a situation as the frontier between two branches of knowledge, present the familiar facts of one side of the line in a way that would have freshness and perhaps interest on the other

News and Views

THE Postmaster General has written an excellent letter, dated Mar 27, to the Baird Television Development Company He states that he has seen a demonstration of the Baird system and that he could recognise with sufficient clearness the features and movements of persons posed for the purpose in the transmitting studio He is a little doubtful whether it is at present practicable to reproduce simultaneously more than two or three individuals, and they must be staged in very close proximity to the transmitting apparatus In his opinion the Baird system represents a noteworthy scientific achievement Taking into consideration the present limited scope of the objects which can be reproduced, he does not consider that it is at present practicable to include television in the broadcasting programme in broadcasting hours He is anxious, however, to give facilities so far as practicable without impairing the broadcasting service for continued and progressive experiments to be made with the Baird apparatus He consents to a station of the British Broadcasting Corporation being utilised for this purpose outside broadcasting hours The Company would probably have little difficulty in negotiating satisfactory terms with the Corporation It is very desirable that experimental demonstrations of television should be accompanied by the broadcasting of speech Consequently, two wave lengths and two transmitters are required It would be very difficult to provide a second transmitter in a suitable locality which would not interfere seriously with important radio services in central London, until the new station of the B B C at Brookmans Park be opened next July In the mean time, the engineers could jointly discuss the best methods In order to get a television service during broadcasting hours, wave lengths outside the bands now being used for speech broadcasting must be used Unfortunately, these bands are much congested It is important, therefore, that the Company should press on with experiments on as low a band as possible Purchasers of receiving apparatus are warned that they buy them at their own risk, as the system is not yet sufficiently advanced to warrant giving it a permanent place in the broadcasting programmes

IT is interesting to learn from a *Daily Science News Bulletin*, dated Feb 26, issued by Science Service, Washington, D C, of the paternal attitude adopted by the Federal Radio Commission towards the many applicants who are anxious to start television broadcasting in the United States Eleven licences for television broadcasting have already been granted, but in all cases precautions have been taken that such activity is for a limited period and is purely experimental The licences are only for six months The broadcasters have to give monthly reports of their activities and of the scientific work they are doing to advance the art The Commission apparently is not yet convinced that radiovision can render real service comparable, for example, with that of sound broadcasting They are naturally anxious to prevent anyone broadcasting radiovision with the main purpose of selling radiovision receivers The Commission has allotted to radiovision, or, as they call it, 'visual broadcasting,' which includes still pictures, 'radiomovies,' and pictures of living actors, four bands of frequencies

The first two bands are between 2000 and 2200 kilocycles (136 150 metres) and the other two bands are from 2750 2950 kilocycles A further band between 2200 and 2300 kilocycles for radiovision may also be used in the future provided that it does not interfere with Canadian stations The present radiovision broadcasting stations are situated in New York, New Jersey, Washington, East Pittsburgh and Springfield, Mass, Schenectady and Oakland in California Many applications are still pending, and hearings will be held to determine "whether or not public interest, convenience, or necessity would be fulfilled by granting their applications" No television broadcasting (that is, by wire) will be allowed on any frequency in the broadcast band, except between 1 A M and 6 A M

AT a recent meeting of the Royal Statistical Society, Dr E C Snow, who read a paper on "The Limits of Industrial Employment," said that before the War the population of Britain was increasing by about 350,000 a year, but now the annual increase is not much more than half this figure In ten years time it is estimated that the increase will not be much more than 100,000 per annum Important changes have taken place in the age distribution of the population In the decade before the War, 130,000 of the annual increase occurred in the age group 30 45 (probably the most important period of life as regards the demand for goods for consumption) and only 50,000 in the group above 60 At the present time the former group is increasing by only 30,000 per annum, while those over 60 are increasing by more than 100,000 per annum These changes, Dr Snow said, are of importance in the study of the unemployment problem Modern industry requires a continuously expanding market since many workers are engaged in manufacturing machinery and other capital goods which will help to increase future production But if population does not increase correspondingly, a state of over production will arise and this will react on the employment capacity of industries which produce capital goods or their raw materials The effect on employment is cumulative, because those who manufacture capital goods are themselves consumers, and their demand as consumers will be reduced The effect is the more severe in Britain because this country is far more dependent upon industrial activity for employment than any other

ON April 6 occurs the centenary of the death of Niels Henrick Abel, the brilliant young mathematician who died at the early age of twenty six Born at Findoë, Norway, on Aug 5, 1802, the son of a minister, Abel was educated at the Cathedral school and University of the capital, and from the age of sixteen gave evidence of striking mathematical powers After the death of his father he was supported by the professors, and later by a pension from the government He travelled into Germany, Italy, Switzerland, and France, became intimate with Crelle, but it is said that his visit to Paris proved disappointing After his return to Norway, however, Legendre, Poisson, and Lacroix wrote to the King of Sweden on his behalf, but no notice was taken of the letter, and a few months later Abel died of consumption at Arendel "The great point," said De Morgan, "to which Abel turned his attention was the theory of elliptic functions Legendre, who had devoted a large portion of his life to the development of these functions and the formation of tables by which to use them, found himself, when his toil was just finished, completely outdistanced by the young Norwegian of whom no one had ever heard" The centenary of Abel's birth was celebrated with great enthusiasm at Oslo in September 1902, when honorary degrees were conferred on many men of science, among whom were Kelvin, Rayleigh, Salmon, and Stokes, while in 1908 a striking monument to him was erected close to the University building

THE differences of opinion which have arisen on the subject of the management of the New Forest have already been alluded to in NATURE The Forestry Commission, on taking over the Crown Forests from the Woods and Forests branch, commenced certain sylvicultural operations in the Forest without reference to local opinion—operations which were viewed with alarm by a certain section of the public The ideas of this section were powerfully voiced by the New Forest Association, which represents, amongst others, the right and privilege holders (i e the commoners) In how far the New Forest Association can claim to voice the opinion of the general public is open to doubt It is this view of the question which Mr H H Haines, a well known botanist and formerly a member of the Indian Forest Service, considers in a small pamphlet which he has prepared and circulated to the members of the Society for the Promotion of Nature Reserves, fellows of the Linnean and Royal Societies, and others Although we are not in agreement with all Mr Haines's contentions, he presents the case for a correct management of the New Forest in a perfectly straightforward and fair manner If the absence of all efficient management which has persisted for many years is maintained, the most beautiful parts of the Forest are doomed to disappear Professional opinion is at one on this matter Since Mr Haines can speak on the sound professional side, whilst being at the same time a botanist and a Nature lover, his small brochure, which unfortunately bears no title, should be read by all lovers of the New Forest

IN the Final Report of the Committee on Industry and Trade, which has recently been issued (Cmd 3282 London H M Stationery Office, 1929 *5s 6d* net), considerable stress is laid upon the benefits which would accrue to industry in Great Britain from the greater recognition of the value of scientific research In certain other countries, notably Germany and the United States, a very great amount of research is carried out by various industrial associations, corporations, and combines, and even by large individual concerns, though in Britain the importance of scientific research is imperfectly realised by the leaders of industry In the opinion of the Committee, a change in this attitude would open up prospects to British industry which at present are beyond the

range of possibility It is true that certain large works in Britain carry out much research work, but for the most part this consists of mere routine testing, or what has been called 'tactical' as distinguished from 'strategical' research, that is, the improvement of results obtained from a given process or the investigation of fundamental laws The latter has to be undertaken by the State or by co operative research associations which represent a joint effort of the industries themselves and the Department of Scientific and Industrial Research The Committee suggests that the most hopeful direction of future development is to define more and more clearly the line of demarcation between the kind of research which is the special function of the State, namely, that concerned with fundamental scientific problems and their application to industry as a whole or to great groups of industries, and that which is the proper function of industrial undertakings either singly or in co operation

THE Committee finds most cause for disquietude in the relations between the research associations and the industries themselves, since the response to the propagandist efforts of these associations is frequently most disheartening, even when full allowance is made for difficulties such as trade depression and the expense of installing new plant and processes It recommends that every important trade association should take into consideration the existing means of disseminating technical and scientific information and, where these are inadequate, should take steps to establish suitable machinery for the purpose The research associations on their part should engage in a campaign of publicity and explanation in order to popularise their results There should be some responsible, suitably qualified officer on the staff of each firm, whose duty it would be to follow the progress of scientific research as summarised in the bulletins received It is also essential that at least an adequate proportion of the responsible heads of industry should have the scientific habit of mind, though it is not necessary that they should themselves be trained researchers "Before British industries, taken as a whole, can hope to reap from scientific research the full advantage which it appears to yield to some of their most formidable trade rivals, nothing less than a revolution is needed in their general outlook on science and in the case of some industries at least, this change of attitude is bound to be slow and difficult, in view of our deeply rooted industrial traditions"

THE wireless organisation for the air mail service to India, which opened on Mar 30, is such that the aircraft engaged will be in touch with aerodrome ground stations throughout the 4700 air miles of the journey On the London to Basle section, the present wireless organisation for continental aviation will be employed The aircraft are fitted with Marconi sets of 150 watts power (Type AD6), adapted for communication over distances of 200 to 300 miles either by telephony or telegraphy From Basle the night train to Genoa makes the connexion with the second section of the air route, from Genoa to Alexandria, operated by three 'Calcutta' flying boats fitted with the more powerful Marconi Type AD8 sets These sets are also adaptable for telegraphy or telephony, enabling the pilots to keep in touch with Italian and British Air Ministry wireless stations until arrival at Alexandria In addition, Imperial Airways, Ltd, which is conducting the London Karachi service, has stationed a depot ship in the Greek Archipelago This has been fitted with a Marconi valve transmitter of ½ kilowatt power (Type U) and suitable receiving equipment (Marconi Type RG19 Receiver), and will be capable of communicating with Malta, Alexandria, and other stations concerned with the service At Alexandria a change is made to aeroplanes again for the final section of the route, through Basrah and over the Persian Gulf to Karachi Part of this section has been in operation for some time, employing De Havilland aircraft fitted with Marconi AD6 apparatus and communicating with R A F stations and a ½ kilowatt station at Rutbah Wells During the flight from Basrah to Karachi, the machines will be in touch with two Marconi stations in Persia, at Chabar and Bunda Abbas The terminal wireless station at Karachi is one of the most powerful aerodrome stations installed at any air port, consisting of a 6 kilowatt Marconi transmitter with direction finder receiving apparatus Many features of the Marconi apparatus for this service have been specially designed to meet the conditions existing on this new route

AT the meeting of the Illuminating Engineering Society on Mar 19 a paper on architectural lighting was read by Mr Waldo Maitland The author defined this term as implying that the lighting becomes an essential part of the architectural scheme, and in some cases the major element Amongst the devices adopted, luminous panels in the ceiling and walls, lighted columns and lintels, and cornice lighting were mentioned, but in the examples shown by Mr Maitland, which included a number of original lighting schemes adopted in Paris, many other novel methods were illustrated This mode of lighting has been adopted at present mainly in the case of large stores, restaurants, and places of entertainment, but it has evident possibilities in modern buildings of architectural distinction Naturally these methods, which involve the reflection of light from diffusing surfaces (concealed lighting) or its transmission through more or less dense translucent glass, may require a higher consumption of energy than do conventional methods But in many cases a sacrifice in efficiency might be tolerated in order to obtain the desired picturesque effect Complete success, however, can only be obtained when the co operation of the lighting expert and the architect can be secured in the early stages of the design of the building At the conclusion of the meeting a series of demonstrations were given in the architectural lighting room of the E L M A Lighting Service Bureau, various pleasing combinations of lighting from artificial skylights, cornices, luminous bands encircling the room, and luminous lintels and doorways being shown The underlying idea is based on the recognition that whereas the buildings of the past were designed solely with a view to appearance by daylight, appearance by artificial light is now

frequently of equal importance This consideration may materially influence the architecture of the future

ALTHOUGH little is now heard of Tutankhamen in the daily Press, the tomb continues to provide from its store a wealth of objects both of intrinsic beauty and of interest to the student of Egyptian culture In the *Times* of Mar 30 is given a long list of articles from it which have recently been added to the Cairo Museum Some of these are unique and many of unusual type Among these is the only existing example of the well known sickle sword known as 'Khepeth' with which the King slew his enemies A model sickle of wood inlaid with gold in the shape of the jaw bone of an ass has red, blue, and purple glass in place of the more usual serrated edge of flint Especially interesting are head rests of an entirely new form One is of blue faience with gold and polychrome glass, another of light blue glass, and a third is made like a three legged stool with legs ending in goose feet and with a grotesque figure of the god Bes with its tongue out on top Boomerangs include some apparently of the returning Australian type and unlike the Egyptian throwing stick type Another object which is unique is the King's game board It is made of polished ebony marked off into 30 squares, of which some are marked with hieroglyphs The pawns are of faience, and in a drawer in the board were two ivory knuckle bones and dice in the form of sticks, black on the one side and white on the other Miniature boards of the same kind were also found Of special interest to technologists were a wicker basket covered with linen on which were a design in yellow, blue, red, and white beads, and a pattern of beads representing captives on top, and a bow fire drill with which was a piece of wood bored with twelve holes and marked with charring, which had apparently been used with the drill for producing fire

A NOTABLE extension of the Manchester Museum is recorded in the *Report* for the year 1927–28 The Haworth Extension Building, which now becomes the centre and main entrance of the Museum as a whole, was erected at a cost of approximately £29,000, and £5000 has been spent upon cases and fittings The Haworth benefaction, a handsome gift, to which the extension was due, provides a further £1100 for additional cases, and a sum of £15,000 as a permanent endowment Formally opened by Mrs Jesse Haworth on Nov 28, 1927, the building has been devoted to the exhibition of ethnological collections in a series of alcoves, which serve to emphasise the geographical and racial human groups, while room has also been found for comparative series of weapons and utensils Of the six floors of the building, the top and the basement, more than a third of the available area, have been allotted to work rooms and the storage of study collections—a welcome indication that the needs of the student as well as of the ordinary museum visitor are being kept well in view The removal of the ethnographical collections has permitted an expansion of the natural history collections, and the rearrangements thus made necessary are now in progress It is an excellent sign of the place taken by the Museum in the education of the city that the Education Authority has delegated five teachers to conduct school classes in the galleries, to the extent of a hundred classes weekly, and the rearrangement of the collections will now enable these teachers to be provided with special rooms for their class work

THE generally admitted superiority of American monthly journalism is challenged by a new monthly, entitled *The Realist*, the first number of which was published by Messrs Macmillan and Co, Ltd, at the end of March This journal is to be devoted to science, industry, art, and economics, and the general editor is Major Archibald Church An editorial board has been appointed, on which the interests of science are represented by such names as Prof F G Donnan, Sir Richard Gregory, Mr J B S Haldane, and Prof Julian Huxley The new magazine stands for scientific humanism, and we are invited editorially to test its scope by an examination of the subjects and writers of the articles published in this first issue Literature is represented by Arnold Bennett, who writes on the progress of the novel, and by Aldous Huxley, who writes on Pascal Among the subjects of articles of scientific interest are "Rejuvenation" by Norman Haire, "Science and the Farmer" by Sir Daniel Hall, 'Scientific Humanism' by Dr Charles Singer, and other articles deal with architecture, music, and the movies' *The Realist* is excellently printed and produced, and if the high standard set by the first number is maintained the journal will soon secure wide recognition

THE non magnetic yacht *Carnegie* arrived at Papeete, Tahiti, on Mar 13 Conditions throughout the passage from Callao, Peru, were excellent On Feb 16 the soundings obtained showed depths from 2700 metres to 5400 metres and back to 4100 metres over a distance of 50 miles, the ocean deep thus revealed was named 'Bauer Deep' Two uncharted submarine ridges were also discovered and rapid slopes off Tatakoto and Amanu Islands were determined On Mar 8 five hours were spent ashore on Amanu Island The bottle sample obtained at 2100 metres on Mar 10 (latitude 17° 6 south, longitude 141° 9 west) contained a few fragments of black lava with no trace of ooze, indicating recent volcanic origin The work done on this passage included 63 determinations of magnetic declination and 17 of magnetic intensity and inclination, 17 ocean stations, at 15 of which bottom samples were obtained, 206 soundings, 35 pilot balloon flights, one of which was followed to a height of more than 6 miles, 8 determinations of evaporation, 4 series of atmospheric electric observations by eye readings, each throughout 24 hours, and 23 complete 24 hour photographic electrograms of potential gradient The vessel left Papeete on Mar 20 for Apia, Western Samoa, she will also make a short stop at Pago Pago, American Samoa

HIS Royal Highness the Prince of Wales has consented to become patron of the Society for the Preservation of the Fauna of the Empire, which was founded in 1903 by a group of animal lovers with the object of awakening public interest in the great heritage of wild life existing all over the British

Empire It has a very energetic president in the Earl of Onslow, and has helped in the formation of the many sanctuaries and national parks which are now to be found throughout the Empire There is, however, much more work to be done in this direction, and the Society needs further support in order that it may continue to carry out its objects efficiently The Society's secretary is Col J Stevenson Hamilton, well known for his work in the formation of the Kruger National Park recently opened in South Africa Further information about the Society can be obtained from the secretary, S P F E, c/o Zoological Society, Regent's Park, London

HIS Royal Highness the Prince of Wales has consented to become an honorary member of the Linnean Society of London

WE much regret to announce the deaths of the Right Hon Lord Avebury, on Mar 26 at the age of seventy years, and of Lord Montagu of Beaulieu, K C I E, C S I, on Mar 30 at the age of sixty two years Lord Avebury was a trustee and also the honorary treasurer of the British Science Guild, and Lord Montagu was president of the Guild in 1920–22

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —A government chemist in Fiji—The Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, Whitehall, S W 1 (April 10) A lecturer in metallurgy at the Technical College, Bradford—The Principal Technical College, Bradford (April 12) An assistant lecturer in preparing, combing, and spinning and yarn manufacture at the Bradford Technical College —The Principal, Technical College, Bradford (April 12) An established analytical chemist, Class II, in the Royal Naval Cordite Factory, Holton Heath, of the Scientific Research and Experimental Department of the Admiralty—The Secretary to the Admiralty (C E Branch), Whitehall, S W 1 (April 13) A fellowship in the department of Coal Gas and Fuel Industries of the University of Leeds for post graduate research in gas chemistry—The Clerk to the Senate, The University, Leeds (April 19) A senior chemist under the Northern Coke Research Committee, Armstrong College—Prof H V A Briscoe, Armstrong College Newcastle upon Tyne (April 22) A director of the Dental Prosthetic Laboratory, Guy's Hospital Dental School—The Dean, Guy's Hospital Dental School, London Bridge, S E 1 (April 30) A professor of imperial economic relations, tenable at the London School of Economics—The Academic Registrar, University of London, South Kensington, S W 7 (April 30) A head of the Navigation Department of the L C C School of Engineering and Navigation, Poplar—The Education Officer (T 1a), County Hall, Westminster Bridge, S E 1 (May 13) A government analyst, Cyprus—The Private Secretary (Appointments) Colonial Office, 2 Richmond Terrace Whitehall S W 1 An assistant editor of *Science Abstracts*—The Secretary Institution of Electrical Engineers, Savoy Place, W C 2

Our Astronomical Column

STUDIES OF PROPER MOTION —Prof J Comas Sola, of Fabra Observatory, Barcelona, contributes an article on this subject to *Scientia* for March It begins with a historical review of the subject, and goes on to describe the modern methods of picking out stars with sensible motions by means of the stereocomparator This is essentially a stereoscope in which plates taken at an interval of a few years are viewed simultaneously by the two eyes Prof Sola has devised an improved form in which the plates can be rotated so that the displacement due to proper motion of the two images of any star is parallel to the line joining the eyes He states that an interval of 20 days between the exposures suffices to give a sensible displacement in the case of 61 Cygni, the motion of which is 5 2″ per annum The focal length of the camera employed is only 80 cm He makes a comparison with the 'blink' micrometer, but considers his instrument superior Work of this kind is very useful for detecting faint stars with appreciable proper motion

WOLF'S PERIODIC COMET —Prof M Kamiensky, Director of Warsaw Observatory, has been engaged for many years in a detailed study of the perturbations of this comet from the date of its discovery in 1884 to the present time At the aphelion passage between 1918 and 1925, it approached very closely to Jupiter and suffered large perturbations that increased its perihelion distance from the sun by nearly a unit These enormous perturbations were so accurately computed that the comet was found close to the predicted position

Acta Astronomica for January 1929 contains a careful recomputation by Prof Kamiensky of the perturbations between 1891 and 1898 He had previously used A Thraen's results for this revolution, but finding that he did not use the latest values for the planetary masses Prof Kamiensky has repeated the work with the greatest care, carrying the work to units of 0 001″ The differences from Thraen, after allowance has been made for the different masses employed, are very small But it was necessary to repeat the work to obtain the degree of accuracy necessary to link together all the apparitions of the comet in a rigorous manner

CLUSTERS OF UNIVERSES — It has been long known that there is a rich nebulous region in Virgo and Coma Berenices, close to the north pole of the galaxy The nebulæ in this region are of the type which Dr Hubble's researches marked out as external galaxies, so that we have evidence that these objects are not scattered uniformly but are aggregated more densely in some directions than in others In *Harvard Bulletin*, No 864, Prof Harlow Shapley and Miss A Ames show that, in addition to the main assemblage, the distance of which is given as about 10 million light years, there are three other adjacent 'clouds of galaxies' these are fainter and smaller, so are probably much more remote The correlation between magnitude and angular diameter indicates the relation $m = 24\ 15 - 5 \log d$, where m is the apparent magnitude and d the diameter in seconds This equation would indicate the perfect transparency of space the departure from it is so small that it is estimated that the loss of light through absorption in space does not exceed one fifth of a magnitude in a hundred million light years This of course is not true in the special regions in our galaxy where there is strong evidence of local absorption by dark matter, as, for example, in the 'Coal Sacks'

Research Items

Witchcraft in Southern India.—In *Man* for March, Mr. F. J. Richards publishes photographs of houses in Arantāngi, Tanjore, which have been demolished by their owners in their fear of 'black magic'. On the occasion of a visit to the village in 1900 he found the Brahmins in a panic, stripping the thatch from the roofs of their houses and removing their belongings into the street. On the previous night no less than seven houses had been set on fire by supernatural agency, and the whole Brahmin quarter had been pelted with stones thrown by invisible hands. Stone-throwing continued in broad daylight, and when another fire broke out the householder brought to the author a rag ball a little bigger than a tennis ball which had been found under the eaves. Tow and rag had been rolled tightly together. It was damp and was said to smell of phosphorous, though this was not perceptible. In the centre was a small fruit stone—held by the villagers to be conclusive evidence of sorcery. The kitchens were desecrated with blobs of boiled rice, coloured yellow or magenta, and mixed with clippings of human hair and nail parings. These were found secreted in and about the cooking places. This defilement of places of which the ceremonial cleanliness is of the utmost importance, was especially to be noted. The Brahmin quarter was the residence of the most intelligent and prosperous section of the village. It was suggested that blackmail was the origin of the visitation. Some professed expert in sorcery had demanded a contribution from each household and had been refused. This was his retaliation.

A Pile Dwelling at Brentford.—In *Antiquity* for March, Dr. R. E. M. Wheeler describes some investigations recently carried out on the foreshore and in the bed of the Thames at Brentford. In 1928 public attention was attracted by the frequency with which bronze weapons and implements were found in the neighbourhood, and especially near the meadow "Old England" just above the junction of the Thames and the Brent, particularly through the collections made by Mr. G. F. I. Lawrence. Mr. O. G. S. Crawford has suggested that this may be the site of one of a number of settlements of lake dwelling peoples from Switzerland of the late Hallstadt Iron Age. A fund was raised for excavation through the *Daily Express*. The result was the discovery of a Romano-British pile dwelling—the first of the period recorded in the British Isles. As the excavations were below tide level they were carried out under great difficulty and only part of the site was uncovered. This, however, was sufficient to indicate the existence of a rectangular dwelling. Piles were found in position with part of the floor of the hut. The first indication of the date of the structure was a complete Roman pot found above this floor. The structure of the floor was as follows. A pile was driven more than three feet into the gravel—how much more it is impossible to say; a horizontal beam was laid on the pile on the level of the gravel; then a layer of green clay was laid on the gravel to the height of the beam—6-7 inches. Upon this was laid a longitudinal layer of wattle. Upon this was a second horizontal timber and then a further layer of clay. A double layer of wattle formed the final floor, nearly 2 feet above the gravel. The timbers were unsquared. A Roman roofing tile beneath the wattle floor in the upper layer indicated the period. Roman pottery and roofing tiles were found around the hut. In the surface of the gravel, fragments of coarse pottery were found which can with confidence be assigned to the half millennium 1000-500 B.C., known in Central Europe as 'Hallstadt'.

Photosynthesis in the Sea.—The Annual Report for 1927-28, drawn up by the executive to the council of the Scottish Marine Biological Association, shows a satisfactory financial situation, the greater part of the expenses of the marine research being defrayed by the Development Fund of H.M. Treasury, together with an amount contributed from local sources. Miss S. Marshall and Mr. A. P. Orr having been granted leave of absence in order to join the Great Barrier Reef Expedition, temporary appointments have been made to fill their places. Before leaving, their researches on photosynthesis in the sea had been continued, including further experiments on diatom cultures enclosed in glass bottles suspended at different depths in the sea, the oxygen produced being measured. From the results it was concluded that the light intensity at which photosynthesis just balances respiration in these inshore waters is never deeper than 20-30 metres even in summer. As the surface is approached the increasing light enables more photosynthesis to take place, but this increase only goes up to a certain depth, above which the light is too strong. During the spring maximum the diatoms are so numerous that they shut off a considerable amount of light and the compensation point rises. Different species behave in different ways. The members of the genus *Chætoceros*, summer forms in these regions, were found to be more sensitive to sunshine than those of *Coscinodiscus*, which are chiefly spring forms, both in cultures and naturally in the sea. Two papers have been published by these authors in the *Journal of the Marine Biological Association* in 1927 and 1928, "The Relation of the Plankton to some Chemical and Physical Factors in the Clyde Sea Area" and "The Photosynthesis of Diatom-Cultures in the Sea."

Decapoda of the *Siboga* Expedition.—Dr. J. G. De Man has continued his studies of the rich material of the *Siboga* expedition, his latest report dealing with the Thalassinidæ and Callianassidæ (*Siboga* Expeditie Monog. 39 a6, Leyden, December 1928). This report, which amounts to a partial monograph of the group, gains particular value from the list of species known in each genus and the tables for their identification. The *Siboga* material includes 10 species of *Upogebia*, of which 5 are new, and 15 of *Callianassa*, of which 12 are new. This large proportion of new species shows how little those burrowing forms are known. Dr. De Man illustrates this point by saying that, out of 76 species of *Callianassa* described, 46 have not been seen since their description. No one to this day knows the manner of life of *Jaxea nocturna*, which has been known since 1818. Its larva is commonly met with on the coasts of Britain, but the adult has been taken only twice. There is one omission from this report which is difficult to understand—*Naushonia crangonoides*. In one of his earlier reports, Dr. De Man includes it among the Crangonidæ, but he does not mention it here at all. There is no doubt whatever that it is not a crangonid but a thalassinid, and it is almost certain that it is closely related to *Jaxea*. The author does not enter into the question of the phylogeny and systematic position of these remarkable and probably very ancient Decapoda; but his extraordinarily detailed description of the species will be valuable material with which to build. The last word has certainly not been said as to the position of the Thalassinidea among the decapods or their relation to one another.

A Japanese Oligochæte.—Mr. Hironori Yoshizawa gives an interesting and detailed description of

the freshwater oligochæte *Stylaria lacustris* which is very common in the pond of the Biological Laboratory, Tôhoku Imperial University ("On the Aquatic Oligochæte *Stylaria lacustris* L." *Science Reports of the Tôhoku Imperial University*, 4th Series (Biology), Sendai, Japan, vol 3, No 4, Fasc 1, 1928) The worm is remarkable in having an elongated prostomium It was cultured in the laboratory, the cultured specimens being used for the present work These all attained sexual maturity in early autumn, September and October being the natural time for the sexual form in the pond The food consists of diatoms, other algæ and vegetable debris One of its enemies is *Hydra*, which swallows the worm, helping it down with its tentacles (body length of the worm 8 11 mm) This reminds one of *Protohydra*, which can swallow oligochætes much longer than itself, and in that case with no tentacles at all Asexual forms are found in spring These are rather shorter and thinner than the sexual worms and fission may take place in three or even in four places The front portion forms a new tail by adding a number of posterior segments, and the hind portion adds five new segments anteriorly to form a new head As a rule, fission proceeds from the ventral plane, midway between the anterior and posterior septa of the segment There are usually twenty five segments, 16, 17, 18, 19, and 20 being the segments which most frequently undergo fission

LIVING FORAMINIFERA IN THE TRANSCASPIAN KARA KUM — Up to now only a few marine Foraminifera have been found in fresh waters or in continental waters generally Some marine genera (such as *Polystomella*, *Rotalia*) come up to river estuaries and small freshwater lakes by the sea In the spring of 1927, A L Brodskii (*Priroda*, No 11, 1928) found a numerous fauna of Foraminifera in the wells of the Kara Kum desert These wells lie north east of Askhabad, their depth is 18 20 m , temperature of the water in spring is 17° 20° C , and in some cases the water contains as much as 10 gm of salt per litre The Foraminifera found in the wells belong to the genera *Spiroculina* (a new species *turcomanica*), *Biloculina* (*B elongata* and a new species *turcomanica*), *Textularia*, *Nodosaria*, and *Lagena* They all contained protoplasm, and in some a nucleus or nuclei were found , thus there can be no doubt that they were alive All the Kara Kum Foraminifera are very small in size , whilst the marine *Spiroloculina* and *Biloculina* reach 2 3 mm in length, the Kara Kum representatives of the genera scarcely exceed 0 16 mm Their shells are fragile, transparent, flattened, and smoothed They evidently inhabit salty ground waters of the sands of Kara Kum desert, whence they fall into the wells They are probably relics of the Upper Tertiary seas which once covered the Kara Kum desert Waters of the Sarmatian and the Akchaghyl seas may also have stretched up to there It should be noted that *Polystomella*, *Rotalia*, *Textularia* are still found in the Caspian Sea Masses of valves of *Polystomella* and *Discorbina* are found in the Aral Sea, and it is probable that Foraminifera live there now

REVISION OF THE GENUS TRIGONELLA —In his monograph on the genus *Trigonella*, G Sirjaev proposes a new division of the genus into three subgenera, fifteen sections and numerous subsections The first published part (*Publications de la Faculté des Sciences de l'Université Masaryk*, No 102, 1928) deals with the taxonomy and distribution of twenty one species of the chief subgenus *Trigonella*, one new species from Bokhara and several new varieties being described

WATER METABOLISM IN DUSTY LEAVES —With most plants the transpiration of dust covered leaves is considerably lower than that of leaves which have been recently cleaned, so that after a few hours the former leaves will contain appreciably more water than the latter An exception to this general rule, noted by Luigi Montemartini in the *Rendiconti* of the Royal Lombardy Scientific and Literary Institute (vol 61, parts 11 15), is observed in the case of *Ceratonia siliqua* (L) Here the cleansed leaves, although exhibiting a markedly more active transpiration, yet accumulate more water than those covered with a layer of road dust To explain this exceptional behaviour reference is made to the fact that as Bose showed, transpiration renders more active the circulation and ascent of water in plants, whereas diminution of the transparency and of the permeability to gases of the cuticle by the thin coating of dust determines a decreased production of substances able to retain moisture in the cells It would seem that, with *Ceratonia* leaves, the cuticle presents peculiar features as regards this transparency and permeability and the cellular protoplasm a sensitiveness which under the conditions employed, leads to a retardation of all the vital functions with consequent loss of water when the leaves are dust covered

CYTOLOGY OF ŒNOTHERA —A useful summary of our knowledge of the cytology of *Œnothera* has been published by Prof R R Gates in *Bibliographia Genetica*, 9, 401 (1928) It was in this genus that important correlations between chromosome content or behaviour and genetic phenomena were first discovered Since the original announcement of chromosome numbers in *Œnothera* was made in December 1906 an enormous amount of research has been carried out on many of the species, mutations and hybrids of wild and cultivated evening primroses as is indicated by the bibliography of seven and a half pages attached to this paper, which summarises work up to 1923 with some references to subsequent publications Chromosome numbers in 30 species are now known The improvements in cytological technique in recent years have led to the demonstration of delicate connexions between the ends of the chromosomes, and these determine the peculiar alinement observed in the heterotypic metaphase The meiotic process is certainly telosynaptic The mutant *Œ gigas* was the first investigated tetraploid mutation The first examples of non disjunction were also studied in this genus, and double non-disjunction is now known to occur Trisomic mutations, with 15 chromosomes, are the most characteristic of all the mutations of *Œnothera* and include the well known *Œ lata*, *Œ scintillans*, *Œ oblonga* and *Œ albida* The view that *Œ lamarckiana* is, in spite of the numerous mutations it has thrown, a persistent species of equal value to *Œ biennis* and others of the *Onagra* group, is maintained, though it is suggested that the whole group may be ultimately hybrid in origin Indeed, it is accepted that hybridisation followed by new chromosome linkages and accompanied by mutations, some of them cytoplasmic and some arising in the chromatin, have been largely responsible for the evolution of the genus *Œnothera* as we now know it

THE PARKGATE SEAM IN SOUTH YORKSHIRE —The Department of Scientific and Industrial Research has issued the thirteenth of its physical and chemical surveys of the coal resources of Great Britain (London H M S O , 1929), being an investigation of the Parkgate Seam, which occurs over an extensive area in South Yorkshire and the adjoining parts of Nottinghamshire and Derbyshire The seam is an exceedingly

important one and extensively worked throughout the whole area in question In Derbyshire and Nottinghamshire it is spoken of as the Deep Hard, whilst in Yorkshire to the north of Barnsley it is known as Old Hards The seam is generally considered as capable of being divided into three main sections, namely, the tops, the hards or middle coal, and the bottoms Of these, the middle coal may be considered the most important, it consists very largely of durain The method of investigation in the present report has been to cut some sixteen samples from the Parkgate seam as it occurs in South Yorkshire in the exposed portion of the coalfield, ranging from a little north of Barnsley to just south of Sheffield These samples have then been fully examined, and the results of the examination are reported in detail, the determinations include approximate analysis, ultimate analysis, calorific value, melting point of ash, carbonisation assay, and ultimate and proximate analyses of the four constituents, vitrain, clarain, durain, and fusain The work has been done not only on the whole sample, but also upon the various sections into which each sample could be divided, the sample consisting in every case of a vertical prism of the coal cut from the roof to the floor When, as is sometimes the case, a certain portion of the top coal is left standing to form a roof, such portion has not been included in the sample The report gives evidence of very thorough and careful investigation, and the results should be of value to those engaged in working this particular seam, that is to say, to practically all the collieries working in the area above indicated

A NEW WARM STAGE —An electrically heated warm stage and compressor for use with high power objectives is described by Messrs J E Barnard and F V Welch in the January issue of the *Journal of the Royal Microscopical Society* The apparatus consists of a small box which encloses the heating system, the microscope stage and object holder, and also the objective and substage illuminator The box is in two parts, one of which slides off the other and permits access to the object without disturbing the microscope or its adjustments The two electrical heating elements are clamped on the under side of the stage, one on each side of the condenser, and the leads to them connected to the mains in series with a suitable variable resistance The temperature of the air inside the box is raised and the stage and compressor can therefore be maintained at a constant temperature As the compressor is a relatively large mass of metal, its temperature once raised changes little, and hence the two cover glasses between which the material is placed for observation are also maintained at a constant temperature The apparatus was designed for use in an investigation on bacteriophagic action involving observations of living bacteria for long periods, and for this purpose has proved entirely satisfactory

ULTRA VIOLET LIGHT TRANSMITTING GLASSES —An interesting paper by Starkie and Turner on the composition and properties of ultra violet light transmitting glasses has appeared in the *Journal of the Society of Glass Technology*, vol 12, No 48 An account of the development of these glasses is given, together with some analyses The limits of transmission in the ultra violet and the percentage transmission have been studied for eight commercial ultra violet glasses, and the results show a wide divergence for the different samples The ageing effect of sunlight, known as solarisation, was examined, and an exposure of several months in summer was found to reduce the transmission by more than 10 per cent in some cases Exposure to the light of a powerful arc for several hours brought about much more rapid ageing This ageing is usually accompanied by a colour change from a greenish to a brownish tint, which supports the theory of Starkie and Turner, that the dominating factor in solarisation is the conversion of ferrous to ferric oxide in the glass

THE MECHANISM OF ARCS —It seems now to be generally agreed that it is not necessary for the cathode of an arc to be hot for the discharge to pass The problem therefore arises as to how the current is maintained, if it is not primarily due to thermions from the metal, and to meet this difficulty the suggestion has been made by Prof Seeliger and by Dr Langmuir that there is an 'autoelectronic' liberation of electrons from the surface of the cathode in the high electric fields that are present in the localised region of the cathode fall in potential These fields can be of the order of a million volts per centimetre, and are ample to pull electrons out of a cold metal under appropriate conditions, such as those employed, for example, in the recently revived Lilienfeld type of X ray bulbs Unfortunately this theory requires that the current density in the cathode spot should not fall below about 1000 amperes per sq cm, whereas some arcs in gases at reduced pressure have been described by J Slepian and E J Haverstick in the January issue of the *Physical Review* in which the current density was only about one per cent of this It appears, then, that the field theory is not tenable, if its interpretation by these authors is correct and they have again directed attention in the same paper to a theory proposed by one of them (J Slepian) three years ago, which referred the maintenance of the arc not to any emission of electrons from the cathode at all, but to the thermal ionisation of a layer of gas in its immediate vicinity

RAMAN OPTICAL EFFECT —In spite of the attention that the quantised scattering of light discovered by Prof Raman has already received there are a number of points connected with it that are still obscure Perhaps the most significant of these is the difference in intensity between the Raman satellites and the corresponding infra red absorption bands and maxima of selective reflection Quartz for example, gives rise to Raman satellites equivalent to natural vibrations at 38 μ, 48 μ, and 78 μ, all of which were, until recently, unknown in the infra red spectra M Czerny has now recorded the pair at 38 μ and 78 μ as absorption bands of crystalline quartz, using a grating apparatus (*Zeitschrift fur Physik*, Feb 19), he has, however, found not the slightest trace of a band at 48 μ in this way, although there is an intense Raman satellite corresponding to this wave length The origin of these discrepancies can only be surmised at present but it may be, as the author suggests, that they arise from the fact that for a body to show the phenomena of selective reflection and absorption, the oscillators in it must have other properties than the mere possession of a definite period, whereas possibly the last condition alone suffices to produce a Raman satellite in scattered light

DETERMINATION OF TRACES OF IODINE IN VEGETABLES —McClendon and Remington, in the February number of the *Journal of the American Chemical Society*, describe a method for the estimation of small quantities of iodine in vegetables, depending on combustion in oxygen, the material being fed into a silica combustion tube by a special arrangement so as to avoid soot and tar formation Chlorides and iodides volatilise and are condensed by electrostatic precipitation Low temperature burning in open dishes requires about fifteen hours for 100 grams of dry sample, and does not lead to large losses of iodides if the ash is alkaline and the temperature never exceeds 450° Calcium lactate must be added to vegetables with an acid ash (cereals) in order to make the ash alkaline and to prevent its fusion Combustion is never complete if the ash fuses

Weather and Wireless

MR R A WATSON WATT delivered the G J Symons Memorial Lecture of the Royal Meteorological Society in the rooms of the Society on Mar 20 The lecture was illustrated by the first public demonstration, in Great Britain, of the reception by wireless picture telegraphy of current weather charts and forecasts, and also by the first public demonstration of the cathode ray direction finder Figs 1 and 2 are reproductions of the synoptic chart for 6 P M on the evening of the lecture and of a general inference and forecast based on the same data which were prepared in the Meteorological Office at the Royal Airship Works, Cardington, transmitted by the Fultograph method from the wireless station at Royal Airship Works, and received by wireless in the rooms of the Society before 8 15 P M The reproductions are from photographs of the actual Fultograms received by wireless

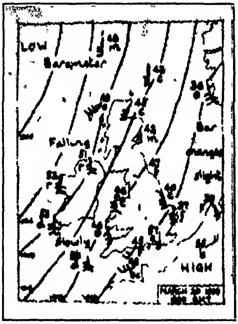


FIG 1 Synoptic chart transmitted and received by wireless on Mar 20 by the Fultograph method

Subjoined is a summary of Mr Watson Watt's lecture

WIRELESS AND WEATHER WARNINGS

Wireless communication is of vital service to the forecaster, particularly in Great Britain, because of five special facts affecting synoptic meteorology, namely, that

(1) Data from very wide areas must be utilised in the preparation of forecasts

(2) British weather comes mainly from the west

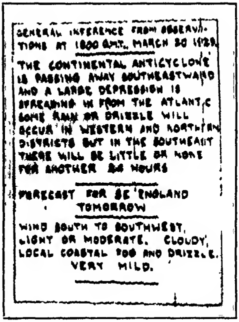
(3) The shortness of the periods for which we can at present forecast makes it imperative that the exchange of data should be extremely rapid

(4) The importance, in navigation, of meteorological data more recent than that available at the time of departure increases rapidly with the mobility, speed, and range of action of the craft concerned

(5) Aircraft require the most detailed meteorological information attainable, on account of the extreme seriousness of the results of meteorological interference with normal flying

The present state of organisation is such that the data for the whole of Great Britain is collected within an hour, sufficient data for Europe as a whole within an hour and a half, while a chart containing data for the whole northern hemisphere at 7 A M is issued before noon Data from the Atlantic shipping routes is of special importance to the British forecaster, and transmission by wireless alone can put it in his hands sufficiently quickly

The broadcasting of weather reports and forecasts is forming a public opinion which will react beneficially on the science by increasing the attention paid to meteorology in education The broadcasting of synoptic charts by picture telegraphy will enhance the value and facilitate the interpretation of the


GENERAL INFERENCE FROM OBSERVATIONS AT 1800 GMT., MARCH 20 1929.

THE CONTINENTAL ANTICYCLONE IS PASSING AWAY SOUTHEASTWARD AND A LARGE DEPRESSION IS SPREADING IN FROM THE ATLANTIC SOME RAIN OR DRIZZLE WILL OCCUR IN WESTERN AND NORTHERN DISTRICTS BUT IN THE SOUTHEAST THERE WILL BE LITTLE OR NONE FOR ANOTHER 24 HOURS

FORECAST FOR SE ENGLAND TOMORROW

WIND SOUTH TO SOUTHWEST, LIGHT OR MODERATE. CLOUDY, LOCAL COASTAL FOG AND DRIZZLE. VERY MILD.

FIG 2 —Written weather forecast transmitted and received by wireless on Mar 20 by the Fultograph method

broadcast reports An experimental period of transmission of current synoptic charts will begin at a very early date, the transmissions being made from Daventry on the Fultograph system Such transmission of charts by one of the wireless methods now available is likely to be of extreme value to the airship navigator, who must be put in possession of sufficient data for the intelligent application of the forecasts sent him The demonstration given showed the transmission and reception of current weather charts and written forecasts, and in particular the reception by wireless picture telegraphy of a synoptic chart for

6 P M of the same evening, together with a written forecast, prepared in the Meteorological Office at the Royal Airship Works, Cardington, and transmitted by wireless from Cardington

The Weather of Wireless

Wireless has a climate and a weather of its own The weakening of signals over different kinds of country, depending on time of day and season, the dependence of atmospherics on latitude, place, and time, are climatological in scope The quick period variations, erratic fading phenomena, and the like, are of the nature of weather, and atmospherics are the rainfall of wireless The history of civilisation is in the main the story of man's progress towards independence of the weather The history of wireless telegraphy is that of progress in the mitigation of these disturbing factors

The study of fading and signal variations is simplified by considering separately the energy which travels along the earth's surface and the energy which, after reaching high levels in the atmosphere, is returned to the ground level by reflection or mirage effects occurring at heights of 50 to 150 miles The ground ray is heavily absorbed, but is not subject to random variations It can therefore be depended upon to give a reliable 'service area' of limited extent around the transmitter Outside this area the ray returned from the upper levels (the 'sky wave' as it is called in America) may arrive in such a relation to the ground ray as to neutralise it, and leave no signal at all, while a slight change in the conditions aloft will cause reinforcement This gives a zone of severe fading outside the service area Still farther out the ground ray is so weak that it can never wipe out the sky wave, and so fading is actually less severe than nearer the transmitter The limited range of the ground ray means that the greater part of the world's wireless communications is carried by the sky wave It is as if stations which are out of range for direct vision communicated by lighting up a cloud layer the illumination of which is then visible at the distant receiver Most of the foreign broadcasting stations heard at night on the average broadcast receiver in Great Britian are heard by this process

Increasing sunspot activity improves the wireless mirror formed by the upper layers, and so improves long wave reception But for short waves these layers act as a cloudy prism rather than as a dirty mirror, and increased solar activity makes the layers absorb short waves more strongly, so impairing short wave wireless

Means have been developed for measuring the heights at which the turning back takes place, and the use of different wave lengths in these measurements should provide valuable data as to the constitution and properties of the atmosphere at great heights

Conditions for the travel of short waves in the upper air are often so favourable that a signal is received directly, and again after it has been once or several times round the world Moreover, it would appear that 'echoes' of this kind have been received owing to waves penetrating the upper layers, and being sent back from a reflecting surface, far beyond the moon's orbit, formed of electrons which have been emitted from the sun

Atmospherics, of which as many as three or four thousand per second can be counted in a tropical night, are found to be capable of disturbing broadcast reception at stations up to four thousand miles from the place at which they originated The average atmospheric applies to the receiving aerial an electric force a hundred thousand times as great as is needed to give a readable signal

The Effect of Weather on Wireless

Atmospherics are found to originate in thunder storms, and the predominant source of the world's supply of atmospherics at any given hour lies in a land where it is summer afternoon The strength of atmospherics radiated from thunderstorms at known distances agrees with that computed from other data about lightning, and the average atmospheric received in England is of such strength as would be radiated from a lightning flash 2000 miles away By means of visual direction finders, of the type demonstrated in operation, thunderstorms can be located by observations at stations one or two thousand miles away

The surfaces of discontinuity between cold and warm air masses, which form the principal features in the modern interpretation of the weather map, produce marked modifications in the strength of signals in the path of which they lie These discontinuities also produce errors in directional observations

The Effect of Wireless on Weather

Dr Johnson has immortalised a brief chapter "Concerning Snakes," the full text of which is 'There are no snakes to be met with throughout the whole island" Thus it is with the frequently alleged effects of broadcasting on the weather

It is to be remembered that all the rainfall of the world must be produced by evaporation, and that the average rainfall of England requires for its evaporation the expenditure of energy at the rate of a third of a million horse power per square mile, night and day, throughout the year This is the approximate power of the Barking super power station, the largest electricity generating station in Great Britain The total rate of emission of energy from all the broadcasting stations of Great Britain and Northern Ireland, in the limited periods during which they are working, is less than 55 horse power, the corresponding figure for Europe being about 400 horse power Any effect of broadcasting on rainfall would, therefore, mean the exercise of control by the expenditure of energy amounting to less than one part in a thousand million, a reaction so sensitive that it could not have escaped detection in the laboratory The scale may be represented in another way by remarking that the annual rainfall for a single tennis court, if the energy required for evaporation were purchased at a favourable rate as electrical energy, would cost about £800, while the London listener pays only ½*d* per annum, in his 10*s* licence fee, for transmitter power The expenditure on transmitter power for all the B B C stations amounts to only ½*d* per licence

Wireless and Weather Warnings

Extensions of the application of wireless telegraphy in meteorological communications may well include the transmission of three colour charts, in which the fronts are indicated in distinctive colours The detection and location of thunderstorms by wireless direction finding on atmospherics has been tested, and further experimental work is likely to lead to applications of this method in the meteorology of air routes It is possible that some of the other measurements of the effects of weather on wireless, as described, may be of use as aids to the forecaster in the identification and location of fronts It may also be possible to trace a relation between measured ionisation gradients at considerable heights and the convective processes in the troposphere

The Stereochemistry of Tellurium

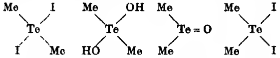
By Prof T M LOWRY, F R S

NEARLY ten years ago the late Mr R H Vernon made a remarkable series of observations on the occurrence of isomerism in the alkyl derivatives of tellurium[1] The initial compound can be prepared by the direct action of metallic tellurium on methyl iodide, $Te + 2CH_3I \rightarrow Te(CH_3)_2I_2$ Silver oxide then liberates from the iodide a weak 'α' base, $TeMe_2(OH)_2$, which when dehydrated undergoes a molecular re arrangement, and is converted into a rather stronger 'β' base From this 'β' base a series of 'β' salts can be obtained, which [illegible] the same composition as the 'α' salts derived from the 'α' base. Measurements of boiling points of solutions in acetone, and of freezing points of solutions in benzene and in nitrobenzene, indicated that the two chlorides had the same normal molecular weight, but that, whilst the α dibromide and the α di iodide were also normal, the β compounds were partially polymerised thus

MOLECULAR WEIGHTS

	α (Obs)	β (Obs)			Calc
Chlorides in acetone	229	226	230	223	228
Bromides in acetone	335	430	459	525	317
Bromides in nitrobenzene		400	445	370	
Iodide in benzene	401				411
Iodide in acetone		509	707		

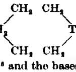
In view of the equality of molecular weights of the chlorides, and of the methods by which the α and β salts were produced, Vernon supposed that they represented the *trans* and *cis* forms of molecules having a square configuration, like that which Werner assigned in 1893 to the isomeric platinous compounds of the type $Pt(NH_3)_2Cl_2$, thus



α Di iodide (*trans*) α Base (*trans*) Anhydrous β Base β-Di iodide (*cis*)

The thorough character of the work the simplicity of the explanation, and the obvious analogy with platinum, won for this scheme an immediate and universal acceptance, and it was a source of pleasure to me, in view of my intimate association with Vernon's earlier activities, to be able to record in December last[2] the fulfilment of Vernon's prediction in reference to the diethyl base that "If this base does not decompose when its solution is evaporated to dryness, but gives diethyltelluronium oxide, the existence of two haloid series would be highly probable" A detailed physico chemical study with Mr Gilbert[3] of Vernon's own compounds had also confirmed the equality of molecular weights of the α and β compounds, since measurements of the freezing points of aqueous solutions gave almost identical values for van't Hoff's i factor, namely, 1 1 for the α and β bases, and about 1 8 for the α and β hydroxychlorides $TeMe_2(OH)Cl$

Although, however, Vernon's experiments were impregnable, and the evidence for identity of molecular weight appeared to be ample, the writer concluded[4] that "The striking difference in colour of the α and β-dihalides shows that the isomerism of the α and β compounds must include some factor which is not expressed completely by merely putting two halogen atoms and two alkyl radicals at adjacent or at opposite corners of a square" Serious reasons for doubting the validity of the whole scheme were found for the first time, however, when further experiments showed[5] that a *cyclo* telluropentane di iodide,



prepared by Morgan, and Burgess[6] and the bases and salts derived from it, behaved in five different points like the corresponding α compounds of Vernon's series, to which he had assigned a *trans* configuration Examination of models showed that, whilst it was easy to form a strainless ring in the case of a *cis* compound, the formation of a *trans* ring involved as usual an intolerable strain which produced a corresponding strain on the theory and made it desirable to look round for possible alternatives An analysis of the facts which were then available, showed that a larger number of them could be covered by assigning to quadrivalent tellurium a tetrahedral instead of a planar configuration[7] but, in order to explain the formation of α and β isomerides, it was necessary to distort the regular tetrahedron, which is accepted universally in the case of sulphur, by making one valency different from the other three

A new series of experiments, described by Dr H D K Drew before the Chemical Society on Jan 17 (*Jour Chem Soc*, p 560, 1929), has removed the last obstacle to a complete analogy between sulphur and tellurium by showing that the changes recorded by Vernon involve an alteration of structure which goes beyond the limits of stereoisomerism This change of structure was actually observed by Vernon, who showed, while the α di iodide and potassium carbonate gave a basic salt,

$$2\ \alpha\ TeMe_2I_2 + K_2CO_3 \rightarrow I\ \ TeMe_2\ \ O\ \ TeMe_2\ \ I + 2KI + CO_2,$$

the β di iodide and potassium carbonate gave tri methyltelluronium iiodide by the wandering of a methyl group,

$$2\ \beta\ TeMe_2I_2 \rightarrow TeMe_3I + \ \ ?$$

Vernon supposed that this wandering took place under the influence of the alkali but Drew's experiments show that it had already taken place in the preparation of the β base, since the β di iodide is itself a complex salt, which can be synthesised readily from the *mono* and *tri* methyltelluronium iodides,

$$TeMe_3I + TeMeI_3 \rightarrow TeMe_3I\ \ TeMeI_3 \text{ or } [TeMe_3]^+\ [TeMeI_4]^-$$

The structure of these compounds was confirmed by a corresponding synthesis of the "β dibromide" $TeMe_3Br$, $TeMeBr_3$, and of mixed halides of the composition $TeMe_3Br$, $TeMeI_3$ and $TeMe_3I$, $TeMeBr_3$

The simple salts from which the more complex β compounds were synthesised are obviously derivatives of trimethyltelluronium hydroxide, $TeMe_3OH$, and of the monomethyl compound Me TeO OH, which Drew describes as telluracetic acid He there

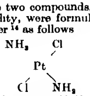
[1] *J Chem Soc*, 117, 86, 889, 1920 119, 105 687, 1921
[2] F L Gilbert and T M Lowry, *J Chem Soc* pp 3179-3189 1928
[3] *J Chem Soc*, 1997 2010 1928.
[4] *J Chem Soc.*, p 308, 1928.
[5] Gilbert and Lowry, *J Chem Soc* 2658-2667, 1928
[6] *J Chem Soc* 321 329, 1928
[7] *Chem and Ind* 47, 1246, Nov 23, 1928.

fore assigned to the β base the structure of an *anhydride*, TeMe$_2$O TeMeO Since, however, the monomethyl compound can be shown to have an acid rather than a basic reaction,[8] it is clear that the mixture of *mono* and *tri* methyl hydroxides should form a *salt* $[TeMe_3]^+$ [Mo TeO O] The correctness of this alternative view can be established from measurements of conductivity,[8] which show that the 'β base' gives a curious series of values ranging from $\Lambda^{25}_{32} = 31$ to $\Lambda^{25}_{512} = 37$ These can be explained by assigning to the cation $[TeMe_3]^+$ a mobility of 50, as in the case of $[NMe_4]^+$, and to the anion CH_3 TeO O a mobility of 30, as in the case of the acetate ion CH_3 CO O, giving a limiting conductivity of 80 for the salt, or 40 for each atom of tellurium, in close agreement with the data recorded above

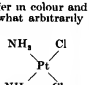
It is important to point out that whilst the *stereoisomerism* of Vernon's theory has been disproved, the *isomerism* indicated by his experiments may still be valid for some of the compounds of this series In particular crystallographic evidence suggests that the α di iodide is itself a complex compound, with a structure that is very similar to that of the β di iodide, there are therefore clear indications that the α dihalides may form complex molecules of the type $[TeMe_2I]^+$ $[TeMe_2I_3]$ which would be isomeric with $[TeMe_3]^+$ $[TeMeI_4]$, although they are evidently more readily dissociated into molecules or ions containing only a single atom of tellurium

The abrupt disappearance of the only evidence which justified the representation of quadrivalent tellurium by a planar model at once raises the question whether the analogous configurations for quadrivalent platinum and palladium are likely to survive In a matter of this kind, prediction is dangerous, but it can at least be said that the planar formulæ for palladium and platinum are supported by a greater variety of evidence and are therefore much less likely to collapse under a single blow The evidence cited by Werner in 1893[9] corresponds closely with that obtained by Vernon So long ago as 1828, Magnus,[10] by the action of ammonia on platinous chloride, obtained a compound which is still known as *Magnus' green salt* This has the empirical composition $PtCl_2$ $2NH_3$ but behaves as a complex salt of the formula, $[Pt\ 4NH_3]^{++}$ $PtCl_4$ When boiled with ammonia it is converted into *Reiset's salt*,[3] $[Pt\ 4NH_3]^{++}Cl_2^-$, which on heating to 250°[11], or on boiling with concentrated hydrochloric acid,[12] is converted into two isomeric forms of the non valent diammine $[2NH_3\ PtCl_2]$ These two isomers, which can be prepared more readily by the action of ammonia on ammonium platino chloride,[13] $(NH_4)_2PtCl_4$, are distinguished, for no very obvious reason, as platosammine chloride and platosemidiammine chloride

The two compounds, which differ in colour and in solubility, were formulated somewhat arbitrarily by Werner[14] as follows



Platosammine chloride
(sulphur yellow)
β or *trans*



Platosemidiammine chloride
(orange yellow),
α or *cis*

On account of their limited solubility, their molecular

[8] Gilbert and Lowry *J Chem Soc* 1997 2010 1928
[9] Werner, *Zeit anorg Chem*, 3 310, 1893
[10] Magnus, *Pogg Ann*, 14 204 1828
[11] Reiset, *Compt rend*, 10, 870 1840 11, 711 *Ann Chim Ph* [3] 11, 417, 1844
[12] Peyrone *Ann Chim Ph* [3] 12, 193, 1844 16, 462 1846
[13] Jorgensen *Zeit anorg Chem* 24, 181 1900
[14] Werner, *Zeit anorg Chem*, 3, 310, 1893

weights were not determined precisely until 1926, when Reihlen and Nestle[15] made a series of observations on the vapour pressures of solutions in liquid ammonia These showed that the *cis* compound had a normal molecular weight, whilst that of the *trans* compound was twice as great On the other hand, Grunberg[16] has obtained normal values for solutions in acetone of both forms of the thiocyanate, $[2NH_3\ Pt(CNS)_2]$, Hantzsch[17] has obtained normal molecular weights for solutions in phenol of both forms of the dipyridyl compound $[2C_5H_5N,\ PtCl_2]$, and Kraus and Brodkorb[18] have obtained normal values for the two forms of $[2C_5H_5N\ PdCl_2]$ and $[2EtNH_2\ PdCl_2]$, as well as for one form of $[2NH_3\ PdCl_2]$, the other being hydrolysed too readily to permit of accurate measurements

Up to this point the story is an almost exact duplicate of the recent observations on tellurium, since the mere multiplication of examples of α and β compounds does not rule out the possibility of an alternative explanation of the supposed isomerism in either case, and the repeated determinations of molecular weights have again provided conflicting evidence It is also open to question whether the occurrence of the same isomerism in tetrammines of the type $[2C_5H_5N\ Pt\ 2NH_3]Cl_2$, might not stand or fall with that of the diammines Fortunately, however, physical evidence is now available which appears to be decisive on the point at issue Thus crystallographic observations have shown that the double cyanides, $K_2[Zn\ 4CN]$, $K_2[Cd\ 4CN]$, $K_2[Hg\ 4CN]$, crystallise in the *cubic* system, and X ray analysis[19] confirms the obvious deduction that the anion has a tetrahedral configuration, such as has already been found in the molecules of $[SnI_4]$, although the ion $[SnCl_6]$ has an octahedral configuration On the other hand, the two pallado chlorides, $K_2[PdCl_4]$ and $Am_2[PdCl_4]$, and the platinochloride $K_2[PtCl_4]$ all crystallise in the *tetragonal* system, and X ray analysis[20] confirms the deduction that the anion has the same symmetry as the crystal and must be represented with the four halogens at the corner of a square of which the metal occupies the centre The planar configuration which Werner assigned to this group of compounds thirty five years ago is therefore now established by a process of mensuration, which does not encourage any hope of its disestablishment by less direct chemical methods

[15] Reihlen and Nestle *Ann* 447, 211 1926
[16] Grünberg *Zeit anorg Chem* 157, 299 1926
[17] Hantzsch *Ber* 59 2761, 1926
[18] Kraus and Brodkorb *Zeit anorg Chem* 165, 73, 1927
[19] Dickinson *J Amer Chem Soc*, 44, 774, 1922
[20] Dickinson *J Amer Chem Soc*, 44, 2404 1922

University and Educational Intelligence

London —Dr Harold Raistrick has been appointed as from Aug 1 to the University chair of biochemistry tenable at the London School of Hygiene and Tropical Medicine, where he will also hold the position of Director of the Division of Biochemistry and Chemistry as applied to Hygiene Dr Raistrick is a graduate of Leeds and Cambridge From 1915 until 1920 he was engaged on research work on the biochemistry of micro organisms for the Medical Research Committee in Sir Frederick Hopkins's laboratory at Cambridge, and since 1921 he has been on the research staff of Messrs Nobel's Explosives Company, Ayrshire, where he organised and equipped a new Biochemical Research Department

The National Union of Teachers held its annual conference this year at Llandudno on Mar 30 The

presidential address, delivered by Mr C W Cowen, of Sheffield, emphasised the increasing, and increasingly necessary, solidarity of the teaching profession and the broadening of the basis of the Union since 1888 when the word 'elementary' was eliminated from its title Referring to the Board of Education's pamphlet on "The New Prospect in Education" and the reorganisations designed to provide advanced instruction for all pupils of secondary school age, the president, while regretting that it has not been decided to enforce throughout England the raising of the age limit of compulsory attendance, pointed out that such reorganisations involve risks of hardship in individual cases and appealed to the Board that local education authorities should not be compelled to proceed immediately with far reaching schemes but invited to put them into operation cautiously and by stages as vacancies arise through retirement or other causes Turning to the relationship between education and industry, and to the gap left by the decay of the apprenticeship system, he expressed the opinion that as an effective training must be based upon an adequate general education, the raising of the school leaving age to at least fifteen years is an essential preliminary to advance He lamented the destruction, attributed to the opposition of small scale employers, of the powerful movement towards day continuation schools He closed with an appeal to teachers to take an even greater part than they do already in all social movements which tend to the uplift of the masses of England

FROM the Universities Bureau of the British Empire we have received a pamphlet (pp 36, price 1s) containing lists of students from other countries in the universities and university colleges of Great Britain and Ireland in the current session The names of the students are grouped, separately for each institution, under the names of the countries to which they belong, and there is a table showing the total number of students from each of the countries named The grand total of these numbers is 5170 The countries contributing most to this total are India and Burma 1575, South Africa and Rhodesia 574, United States of America 556, Egypt 382, Australia and New Zealand 336, Canada and Newfoundland 203, Germany 157, West Indies 128, Ceylon 121, China 93 Of the Indian students more than half are in the London colleges, and of the remainder Oxford and Cambridge have 181 the modern English provincial universities 288, Edinburgh 133, and Glasgow 99 Of the 574 South Africans, 222 are in the London colleges (123 in the medical schools) 163 at Oxford and Cambridge, 100 at Edinburgh Oxford has 168 students from the United States, including 96 Rhodes Scholars, Cambridge 64, London 136, and Edinburgh 127 The Egyptian students are chiefly in the modern English provincial universities (162), especially Birmingham (55), in London (131), and also in Edinburgh (55) Australians and New Zealanders congregate chiefly in Oxford and Cambridge (157), London medical schools (64), and Edinburgh (37), Canadians in the London colleges (77), Oxford and Cambridge (74), and Edinburgh (35) German students have been coming to England in rapidly increasing numbers in the past four years, they are chiefly in London (94), especially the School of Economics (40), and the modern English provincial universities A comparison with similar pamphlets published two years and four years ago discloses some interesting increases grand totals—4385, 4596, 5170, India, Burma, and Ceylon, 1199, 1361, 1696, Germany, 34, 93, 157, and decreases—South Africa, 747, 624, 574, Siam, 79 62, 37

Calendar of Patent Records

April 6, 1852—It was Samuel Fox who introduced the light steel frame for umbrellas and parasols His patent for constructing the ribs and stretchers of steel formed into hollow trough like shapes was granted on April 6, 1852, and the frames were put on the market under the well known 'paragon' mark

April 9, 1788—The first beater thrashing machine was patented on April 9, 1788, by Andrew Meikle, who was led to the invention by making experiments with a machine of a different type which did not work satisfactorily John Rastrick, the engineer, was also trying to solve the problem at the same time, and says himself that he had made machines on Meikle's plan about ten years before the date of the patent, but though there is evidence that Meikle's rights were contested and that he obtained little benefit from his patent, nothing has so far come to light to support Rastrick's claim to be the real inventor

April 10, 1790—The first federal Patents Act of the United States was passed on April 10, 1790, and the first grant under it was made to Samuel Hopkins in the following July Many patents had, however, been issued previously, by extension of English patents by the Crown to include one or more of the colonies, directly by the colonial authorities, and, after the Declaration of Independence, by Acts of the various State legislatures, especially Maryland, Connecticut, Massachusetts and Pennsylvania

April 10, 1811—In the first days of the railway locomotive, it was widely held in spite of evidence to the contrary—that the adhesion of smooth wheels on the rails would not be sufficient to enable heavy loads to be drawn along the railway, and Blenkinsop's rack locomotive was designed to overcome this objection This was patented on April 10, 1811, and was introduced on the tramline of Middleton colliery, near Leeds

April 11, 1807—The modern method of igniting the powder charge in all fire arms dates from the invention of the percussion lock by the Rev Alexander John Forsyth, the patent for which is dated April 11, 1807 Forsyth used as his detonating powder a mixture of potassium chlorate sulphur, and charcoal, but the specification is drawn in wide terms to include all percussion systems, and the patent was held to be good after a strenuous fight in the courts The British government was, however, slow to adopt the new method, and Forsyth received no benefit from his patent, though his heirs were afterwards given a government grant of £1000

April 13, 1847—Theodore Boehm's improvements in the flute, which consisted mainly in the provision of a cylindrical instead of a tapering bore, and the adoption of a system of rings and levers in combination with the keys, whereby the fingers were given much easier control, received a Bavarian patent for five years on April 13, 1847 The introduction of the new flute raised a great controversy both as to the merits of the new construction and to Boehm's claims to be the inventor, but its use soon became general

April 13, 1869—George Westinghouse's first patent for a continuous air brake for railway trains was granted in the United States on April 13, 1869 The idea did not originate with Westinghouse, but his construction embodying the three way control cock and automatic valves in the connecting tubes, which ensured that the system would still continue to work if part of the train became disconnected, was the first practical system, and was immediately taken up It was greatly improved in the following years, and by 1874 had been fitted to more than 2000 locomotives and 7000 coaches

Societies and Academies

London

Society of Public Analysts, Mar 6 —**Christine Mary Fear** On the alkaloid test for tannin It has frequently been asserted that most alkaloids are precipitated by tannin, but the author's experiments show that the only alkaloids giving appreciable precipitates with tannin solutions alone are brucine, caffeine, cinchonine, cinchonidine, quinine, and strychnine —**A L Andrews** The cryoscopic method for the detection of added water in milk The determination of the freezing point affords a simple and trustworthy means of detecting added water in milk Genuine milk has a freezing point not higher than −0 550° C, when determined by the method in use in the New Zealand Dominion Laboratory If the freezing point rises to −0 530° C, watering may be suspected, and if to 0 520° C, the milk has certainly been adulterated with 5 per cent of added water —**A J Parker** and **L S Spackman** Investigations on the relations between the acidity and freezing point of milk The normal acidity of fresh milk is 0 14 per cent The correction factor is 0 003° C for each 0 01 per cent excess acidity between acidities of 0 17 and 0 60 per cent and 0 010° C for acidities ranging from 0 14 to 0 17 per cent lactic acid When the cryoscopic method is used for the determination of added water in milk, it can be applied with accuracy only when the samples are quite fresh

Paris

Academy of Sciences, Feb 25 —The president announced the death of M J Boussinesq —**Charles Richet** Some statistics on the mortality and age of election of members of the Academy —**L Cayeux** Typical calcispheres are Algæ —**Henri Villat** A problem of hydrodynamics — Guido Castelnuovo was elected *correspondant* for the Section of Geometry in the place of the late Luigi Bianchi —**Paul Delens** The differential geometry of spheres and groups of torsors —**Marcel Vasseur** Deformable surfaces with permanent conical network —**Bertrand Gambier** Quadratic solutions of Moutard's equations —**Alexandre Ghika** The analytical prolongation of a given function by its development in Taylor's series —**D Pompeiu** A geometrical form of the fundamental theorem of Cauchy —**Alex Froda** The relative maxima and minima of functions of real variables —**Z Horák** The conditions of validity of Hamilton's principle —**D Iwanenko** Two remarks on Dirac's equation —**G Ribaud** and **S Nikitine** The realisation of the black body at the melting point of palladium by the tube method —**H Pelabon** The electronic theory of bad contacts —**Jean Lecomte** The elimination of diffused radiations in an infra red spectrometer —**Paul Bary** and **José V Rubio** Observations on colloidal solutions of alumina and chromium oxide and their desiccation —**F Bourion** and **E Rouyer** The determination by the boiling point method of the molecular equilibria of resorcinol in solutions of lithium chloride —**A Chrétien** and **E Cornec** The equilibria between water, sodium nitrate, and sodium chloride —**Albert Roux** and **Jean Cournot** Combined influences of velocity of deformation and of temperature on the production of cold hardening —**B Bogitch** The reduction of fused silicates by carbon monoxide Silicates of copper Metallic copper is produced when the carbon monoxide amounts to 3 per cent of the gas mixture, when the percentage reaches 26 per cent the reduction of the copper is complete —**Mlle M Pernot** The system mercuric iodide, potassium iodide, and acetone —**Mme Ramart-Lucas** and **Mlle Amagat** The comparative stability of isomers according to their absorption spectra Allyl and isoallyl derivatives of the benzene series The absorption curves and thermal stability of these compounds are in agreement with the rules laid down by the authors in earlier communications —**A Michel-Lévy** and **Gaston Grenet** The relation between the increase of the magnetic susceptibility of certain heated rocks and the modifications which occur in certain of their mineral constituents —**Paul Corbin** and **Nicolas Oulianoff** Mylonitic zones with hercynian orientation in the massif of Mont Blanc —**P Idrac** Some singularities of the Gulf Stream —**H Buisson** Measurements of the ozone in the upper atmosphere during the year 1928 —**G Nicolas** and **Mlle Aggéry** A Heterosporium parasite of *Viburnum odoratissimum* —**Louis Rapkine** The rôle of free oxygen in development —**Takir Ertogroul** The origin of the peritrophic membrane in the silk worm —**A Demolon** and **G Barbier** The conditions of formation and constitution of the argilo humic complex of soils The colloidal clay is a fixation factor of the humic colloids of soils The cations absorbed by the clay, especially Ca, condition the formation of clay humus complex This complex can be reproduced starting with its constituents —**Georges Lakhovsky** Explanation of the therapeutic effects of open oscillating circuits on the organism of living beings —**d Arsonval** Remarks on the preceding communication The application of Hertzian waves in therapeutics and their bactericidal action was utilised in France nearly forty years ago —**P Lecomte du Noüy** The rotatory power of serum as a function of the temperature From a study of the rotatory power of normal horse serum for temperatures varying between 0° C and 70° C it is concluded that up to 50° 52° C only very small changes occur in the chemical nature of the serum proteins for a time of heating of about two hours At 55° C a change is noted after twenty minutes heating and above 59° C change is very rapid **Maurice Fontaine** The increase in the oxygen consumed by marine animals under the influence of high pressures Its variations as a function of the duration of the compression The oxygen consumed by *Pleuronectes platessa* under pressures of 100 kgm increases during the compression to a maximum, then diminishes, but remains for several hours above the normal consumption —**P Thomas**, **A Gradinescu**, and **Mlle R Imas** The utilisation of the pentoses in the animal organism —**Mlle Andrée Courtois** The small proportion of cholesterol in the fatty matters from the chrysalids of Lepidoptera

Geneva

Society of Physics and Natural History, Dec 20 —**R Bach** and **A Schidlof** The allotropic states of iron It is generally admitted, from earlier researches, that iron has four allotropic varieties, α, β, γ, δ, and is characterised by the same crystal network for α, β, δ (centred cube), and another face centred cube for γ The authors find confirmation of these views from the study of the variations of the constant of the crystal network in the neighbourhood of the transformation points of the different varieties —**L Reverdin** Faunistic study of the station of Sumpf (Zoug), the Bronze Age (2) The author completes the results of the excavations of 1926 by those of the years 1927 and 1928, obtained at two new places The numerical proportions of the different species vary from one field to the other, but the sheep preponderates Taken as a whole, the descending order is sheep, ox, dog, pig, horse J Favre has determined the molluscs Those of the archæological layer are characteristic of aquatic deposits without exception The presence of *Valvata piscinalis*, var *antiqua*,

shows that it was a lake and not a marsh.—F. Battelli: The relation between the voltage and the duration of the stimulation in the production of convulsions. Continuous current and alternating current (frequency, 45), with the voltage rising from 10 to 86 volts, were applied to the frog. For the lower voltages the action of the alternating current is much more prolonged, but the durations tend to equality starting from 45 volts.

ROME

Royal National Academy of the Lincei, Dec. 2.—**Gino Fano**: S. Lie's representation of the linear element of the plane on dotted space.—**L. Cambi**: Univalent iron, cobalt, and nickel, and nitrosothio salts: reply to W. Manchot.—**A. Palatini**: Constant tensors associated with binary and ternary varieties.—**Maria Pastori**: Noteworthy identities relating to derived tensors.—**C. Burali-Forti**: A question concerning elastic films.—**E. Čech**: The asymptotic correspondence between two surfaces.—**G. Vranceanu**: The equations of the problem of two bodies of variable mass. Levi Civitá has recently considered the problem of the motion of a body, the mass of which varies as the result of the fall of meteorites on to it (astronomical case) and arrives at the conclusion that $\frac{d}{dt}(mv) = F$ should be taken as the fundamental law. The equations of the problem of two bodies of variable masses, which is of astronomical interest, are now considered.—**E. Guglno**: A new interpretation of Gauss's principle of minimum contraction.—**B. Finzi**: The singularity of dynamic actions in the problem of the plane strip.—**R. Serini**: Symmetrical deformations of an elastic strip.—**D. Graffi**: The theory of the transmission of heat by convection.—**Stefano Lodovico Straneo**: Application of the functional method to the study of the cooling of a bar.—**A. Occhialini**: The effect of resistance on a spark spectrum. A method is described which allows of the classification of the lines emitted by an element, and is based on their behaviour when a resistance is inserted in the discharge circuit. Use is made of low voltage spark spectra, and, if the resistance is sufficiently high, the spectrum lacks certain lines, whereas if the resistance is diminished those lines appear adherent to the cold electrode in groups at definite values of the resistance.—**M. Kahanovicz**: Elastic constants in relation to the periodic system of the elements. Elasticities of form, volume, and tension are progressive functions of the atomic number. The relationships are simple proportionalities, and the product of the modulus with the atomic number constitutes a constant characteristic of the group. Various conclusions are drawn concerning the mutual relationships between the different deformations.—**G. Bargellini** and **Lydia Monti**: 2 : 5 Dichlorophenetidine. The dichlorophenetidine obtained by Reverdin and During by treating phenacetin, in acetic acid solution, with nascent chlorine and hydrolysing the resulting dichlorophenacetin, is the 2 : 5 compound.—**R. Altschul**: A new procedure for staining glial cells. Weigert's method for revealing the marginal glia, the fibrous glia, and their relations to the vessels may be greatly simplified and rendered more certain in its results.—**C. Ruiz**: The fauna of the Jurassic volcanic tufas of Roccapalumba, Sicily.—**Constantino Gorini**: Thermobiosis and microbic dissociation. By thermobiotic culture is meant, not adaptation of organisms to high temperatures, but treatment to ascertain if some of the cells are more or less thermophile. This is done by subjecting the cultures, suddenly and as soon as they are inoculated, to temperatures ranging from 50° to 70°, the daily re-inoculation of each culture being made at its own special temperature. In this way a mesophile species of the *Subtilis* group has been dissociated into a strain showing transitory thermo-tolerance and another exhibiting lasting thermo-tolerance.—**G. Testi Dragone**: Fluorescence of vegetable juices in filtered ultra-violet rays. The experiments on the effects of the rays from a Hanau lamp, after passage through a uviol filter, on the latex from plants of various families, have now been extended to the resinous substances of a number of Coniferæ and to the essential oils of the pericarp of various *Citrus* species. The resins exhibit fluorescence, which is usually blue, but sometimes greenish or brownish. These substances, then, protect the parts of the organism producing them from harmful, invisible radiations by converting these latter into harmless radiations of greater wave-length. Similar results are obtained with the oleiferous glands of *Citrus*.—**N. A. Barbieri**: Physiological culture: results and applications. The author has previously shown that it is possible to separate, from vegetable tissues, the soluble and insoluble salts existing preformed therein. These salts as a whole, constitute the physiological fertiliser, which is the saline nutriment most suitable to, and most readily assimilable by, a plant. Various crops, when fertilised on these lines, give favourable yields in comparison with similar crops to which the fertilisers commonly used are applied.—**V. Bambacioni**: Contribution to the embryology of *Lilium candidum* L. Various observations are recorded of interest not only as regards the development of the feminile gametophyte which, perfectly identical with that of *Fritillaria persica*, follows the *Euphorbia dulcis* type and explains in the simplest manner the increase in the number of chromosomes in the nuclei of the chalazal region, but also on account of a number of anomalies, some not previously described.

Official Publications Received

BRITISH

The Hannah Dairy Research Institute. Bulletin No. 1: Surplus Milk and Milk Residues, being the Report of an Investigation into the Utilisation and Marketing of Surplus Milk and Milk Residues carried out for the Scottish National Milk and Health Association and the Empire Marketing Board. By Archibald Macnellage, Jr. Pp. 66. (Glasgow: The University.) 2s. 6d.

The Journal of the Royal Anthropological Institute of Great Britain and Ireland. Vol. 58, July to December 1928. Pp. xiv+305-64+17 plates. (London.) 15s. net.

Report and Balance Sheet of the National Botanic Gardens of South Africa, Kirstenbosch, Newlands, Cape (and the Karoo Garden, Whitehill, near Matjesfontein) for the Year ending December 1927. Pp. 25. (Kirstenbosch.)

Quarterly Journal of the Royal Meteorological Society. Vol. 55, No. 229, January 1929. Pp. 102. (London: Edward Stanford, Ltd.) 7s. 6d.

Department of Scientific and Industrial Research: Building Science Abstracts. Compiled by the Building Research Station and published in conjunction with the Institute of Builders. Vol. 1 (New Series), No. 12, December 1928. Abstracts Nos. 2127-2203. Pp. x+379-403. (London: H.M. Stationery Office.) 9d. net.

British Association Reprints. No. 23: Report on Science in School Certificate Examinations. Pp. 443-582. (London.) 1s.

Journal of the Chemical Society: containing Papers communicated to the Society. February 1929. Pp. iii+217-380+viii. Journal of the Chemical Society: Supplementary Number containing Title pages, Contents and Indexes, 1928. Pp. 3309-3433+xxxvii+4. (London.)

The Indian Forest Records. Silviculture Series, Vol. 13, Part 7: Slash in Chir Pine (*Pinus longifolia*) Forests; Causes of Formation, its Influence and Treatment. By J. E. C. Turner. Pp. vii+46+25 plates. (Calcutta: Government of India Central Publication Branch.) 3.6 rupees; 5s. 9d.

British Research Association for the Woollen and Worsted Industries. Annual Report 1928-29. Pp. 60. (Leeds.)

FOREIGN

Human Biology: a Record of Research. Vol. 1, No. 1, January 1929. Pp. 152. (Baltimore, Md.: Warwick and York, Inc.) 1.50 dollars.

Proceedings of the Imperial Academy. Vol. 4, No. 10, December 1928. Pp. xxxiii-xxxiv+589-625. Vol. 5, No. 1, January 1929. Pp. ii+6. (Tokyo.)

United States Department of Agriculture. Technical Bulletin No. 98: Imported Parasites of the European Corn Borer in America. By D. W. Jones. Pp. 28. (Washington, D.C.: Government Printing Office.) 10 cents.

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol 80 A Revision of Leidy's Collection of Mermithids. By G Steiner Pp. 547-552. A Collection of Birds from Siam. By Rodolphe Meyer de Schauensee. Pp 553-580 Studies on West Indian Mollusks the Genus Zachrysia By Henry A Pilsbry Pp 581-606 Notes on New Jersey Fishes By Henry W Fowler Pp 607-614 (Philadelphia.)

University of California Publications in American Archaeology and Ethnology Vol 25 No 1 Lovelock Cave By Llewellyn L Loud and M R. Harrington Pp viii+183+68 plates (Berkeley Calif University of California Press London Cambridge University Press) 2.50 dollars

University of California Publications in Zoology Vol. 31 No 11 A Study of Physical and Chemical Conditions in San Francisco Bay especially in relation to the Tides. By Robert C Miller William D Ramage and Edgar L Lazier Pp 201-267+5 charts. (Berkeley Calif University of California Press London Cambridge University Press) 85 cents

Ministero dell Aeronautica Aviazione civile e Traffico aereo Annuario 1929 (anno 7) Pp. 211 (Roma.)

United States Department of Agriculture Technical Bulletin No 83 The Pacific Flathead Borer By H E Burke and A G Böving Pp. 36. (Washington, D C Government Printing Office)

Publikationer fra det Danske Meteorologiske Institut Aarbøger Isforholdene i de Arktiske Have (The State of the Ice in the Arctic Seas) 1928 Pp 18+5 maps (København G E C Gad)

Marx Engels Archiv Zeitschrift des Marx Engels Instituts in Moskau Herausgegeben von D Riazanov Band 2 Pp. viii+618 (Frankfurt a M Marx Engels Archiv Verlagsgesellschaft m b H) 12 gold marks

Memoirs of the College of Science, Kyoto Imperial University Series A Vol 12 No 1 January Pp 80 Series B Vol 4 No 2 February Pp 81-163 (Tokyo and Kyoto Maruzen Co Ltd)

CATALOGUES.

Law Crime and the Criminal (Catalogue No 515) Pp 40 (London Francis Edwards Ltd)

Eighteenth Century England a Catalogue of Books and Autographs (New Series No 1) Pp 92 (London Francis Edwards Ltd)

The Bureau of Information on Nickel Ltd Series B Nickel Cast Iron No 4 Nickel Cast Iron in Theory and Practice Pp 8 Series H General No 2 The Bureau What it Is and What it Does Pp 12 (London)

Diffraction Gratings ruled on the Dividing Engines of the Johns Hopkins University Baltimore Md U S A. under the supervision of Professor R W Wood (Rooster 28) Pp 4 (Delft P J Kipp en Zonen)

West Africa Books, Maps and Views relating to the Gold Ivory and Slave Coasts Sierra Leone Nigeria, Dahomey Liberia Benin etc Pp 18 (London Francis Edwards Ltd)

Diary of Societies

FRIDAY April 5

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch) (Annual Meeting) (at College of Technology Manchester) at 4 —J Yates Foundry Organisation

ROYAL SANITARY INSTITUTE (at Council House Birmingham) at 5 30 —H. H Humphries Some Drainage Problems in Birmingham

INSTITUTE OF TRANSPORT (Manchester Liverpool and District Section) (at Manchester), at 6 30 —D R Lamb Sidelights on the Transport Problem

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section) at 7 —E. W Hill Some Technical Considerations concerning Power Factor in Relation to Tariffs

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7 30 - Technical Film showing the Production of Graham Paige Cars in America.

INSTITUTION OF MECHANICAL ENGINEERS (Midland Graduates Section) (at Chamber of Commerce Birmingham) at 7 30 —Wing Comm T R Cave Brown Cave Aircraft Engineering in its Relation to Mechanical Engineering (Annual Lecture).

SATURDAY, April 6

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (Yorkshire District) (at Town Hall Leeds), at 2.30 —Resumed Discussion on the Address by W J Hadfield on The Local Government Bill and the Municipal Engineer with Particular Reference to the Compensation Clauses.

HULL ASSOCIATION OF ENGINEERS (at Technical College Hull), at 7 15 —H E Copp The Carbonisation of Coal

MONDAY April 8

ROYAL SOCIETY OF MEDICINE (War Section) (Annual General Meeting) at 4 30 —Col J C Kennedy, Surg Rear Adml E T Meagher, Squad Leader M I Burton Discussion on Functional Diseases of the Nervous System.

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4.30 —Lt Col L M Davies The Philosophic Basis of Modernism.

ROYAL SOCIETY OF MEDICINE (Orthopædics Section), at 5 —W H Ogilvie A Review of Recent Work on Bone Tumours.—R. Watson Jones Wrist Dislocation with Associated Nerve Lesions.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5 —General Meeting

SOCIETY OF ENGINEERS (at Geological Society) at 6 —G H Gardner Notes on the Inspection of Public Works.

INSTITUTION OF ELECTRICAL ENGINEERS (North Eastern Centre) (Annual General Meeting) (at Armstrong College, Newcastle upon Tyne), at 7 —B L. Goodlet The Testing of Porcelain Insulators.

SOCIETY OF CHEMICAL INDUSTRY (Yorkshire Section) (Annual General Meeting) (at Hotel Metropole, Leeds) at 7 15 —Dr E G Ritchie The Storage of Steam in Industrial Plants

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8 —Major General Sir Fabian Ware The Work of the Imperial War Graves Commission

SURVEYORS INSTITUTION at 8.—B W Adkin The Education of a Young Surveyor

TUESDAY, April 9

SOCIETY FOR THE STUDY OF INEBRIETY (at 11 Chandos Street, W), at 4 —Dr J D Rolleston and others Discussion on Alcohol in Therapeutics

INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5 30 —Dr L. Dudley Stamp The Oil and Gas Fields of Burma.

ZOOLOGICAL SOCIETY OF LONDON at 5.30 —S. R Douglas Further Results of Dr Wilfrid Ashley's Experiment on marking Woodcocks breeding in the West of Ireland —J W Winterbottom Studies in Sexual Phenomena—Continual Display in Birds —W S. Bristowe (a) The Mating Habits of Spiders, with Special Reference to the Problems surrounding Sex Dimorphism (b) (1) The Spiders of the Scilly Islands (2) The Spiders of Lundy Island (3) A Contribution to the Knowledge of the Spiders of the Channel Islands —C J Conolly A New Copepod Parasite representing a New Genus and its Larval Development

INSTITUTION OF CIVIL ENGINEERS, at 6.—H Hall The New Piccadilly Circus Station

LONDON NATURAL HISTORY SOCIETY (at Winchester House Old Broad Street), at 6 30 —J E S Dallas Summer in Switzerland

INSTITUTE OF MARINE ENGINEERS at 6.30 —W E Woodeson jun and J S Gander The Relative Merits of Pulverised Fuel and Mechanical Stoking and their Application for Marine Purposes.

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole Leeds) at 7 —Annual General Meeting

INSTITUTION OF ELECTRICAL ENGINEERS (North Western Centre) (Annual General Meeting) (at Engineers Club Manchester) at 7 —Hon Sir Charles A Parsons and J Rosen Direct Generation of Alternating Current at High Voltages —J A Kuyser Recent Developments in Turbo Generators

INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Section) (Annual General Meeting) (at Royal Technical College Glasgow), at 7 —E B Wedmore Dr W B Whitney and C E R Bruce An Introduction to Researches on Circuit Breaking

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN at 7 —S H Horgan Bringing Photography to the Printing Press.

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Middlesbrough Branch) at 7 30

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND (at 39 Elmbank Crescent Glasgow) at 7 30 —Dr Ing F Sass Experiences with and Investigations on Double acting Airless injection Diesel Engines

INSTITUTION OF AUTOMOBILE ENGINEERS (at Royal Society of Arts) at 7 45 —H S Rowell and C G Williams Automatic Spark Advance

ROYAL SOCIETY OF MEDICINE (Psychiatry Section) (jointly with British Psychological Society Medical Section), at 8 —Dr E Jones Dr H Yellowlees Dr R D Gillespie and others Discussion on The Role of Anxiety in the Psychoses and Psycho neuroses

TELEVISION SOCIETY (at Engineers' Club Coventry Street) at 8 —J C Rennie Some Notes on Exploring

WEDNESDAY April 10

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section) at 6 —T L Eckersley Short Waves

MALACOLOGICAL SOCIETY OF LONDON (in Zoological Department, University College) at 6

ROYAL SOCIETY OF ARTS at 8 —G H Nash Some Modern Aspects of Electrical Communication

ELECTROPLATERS AND DEPOSITORS TECHNICAL SOCIETY (at Northampton Polytechnic Institute) at 8 30 —B Clark Effect of Organic Addition Agents in the Electro-deposition of Copper

THURSDAY April 11

TEXTILE INSTITUTE (at Midland Hotel Bradford) at 7 30 —H T Tizard Science and the New Industrial Revolution (Mather Lecture)

INSTITUTION OF ELECTRICAL ENGINEERS at 6 —B L Goodlet The Testing of Porcelain Insulators

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6 30.—M Lapresle Wind Tunnel Methods of the Eiffel Laboratory

INSTITUTE OF METALS (London Local Section) (Annual General Meeting) (at 83 Pall Mall) at 7 30 —Dr Hankins and others Discussion on Hardness Testing

ROYAL SOCIETY OF MEDICINE (Neurology Section) at 8.30 —Discussion on Disseminated Encephalo-myelitis

NELSON TEXTILE SOCIETY (at Nelson).—F Hughes Sley Construction and Traverse of Shuttle

FRIDAY, April 12

ROYAL SOCIETY OF ARTS (Indian Section), at 4.30 —A. T Cooper Recent Electrical Developments in India

ROYAL ASTRONOMICAL SOCIETY at 5 —L Rosenhead The Annual Variation of Latitude —E A. Kreiken On the Dwarf Nature of the Spectroscopic Binaries —H Horrocks The Longitude of the Royal Observatory Cape of Good Hope, from Wireless Signals, Oct.-Nov 1926 —S A Mitchell Atlas Stellarum Variabilium Series VII

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute Newcastle upon Tyne), at 6

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (Annual General Meeting) (at Engineers Club, Manchester) at 7 —T R. Woolaston Suggestions in Steam Raising

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7 —F E F Durham Pumping Plant

GEOLOGISTS ASSOCIATION (at University College), at 7 30 —E. J Wayland The Later Geological History of the Equatorial Lakes in Uganda

OIL AND COLOUR CHEMISTS ASSOCIATION (Manchester Section) (at Milton Hall, Manchester) at 7 30 —Annual General Meeting

SOCIETY OF CHEMICAL INDUSTRY (Birmingham and Midland Section) (jointly with Chemical Engineering Group) (at Engineers Club, Birmingham) —Dr C M Walter The Design and Operation of Gas Heated Furnaces.

SATURDAY April 13

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (jointly with Yorkshire and North Western Districts) (in College of Technology, Manchester), at 2 30 —W J Hadfield The Local Government Bill, with Particular Reference to the Road Clauses.

SATURDAY, APRIL 13, 1929

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Co-education.

SCIENCE does not give a clear lead on the question of co education The physiological and psychological differences between the sexes are not 'significant enough to determine whether the sexes should preferably be educated together or apart When in 1922 the Consultative Committee of the Board of Education was preparing its valuable report on Differentiation of the Curriculum for Boys and Girls respectively in Secondary Schools it wisely consulted a distinguished medical man the late Dr J G Adami on the anatomical and physiological differences between the sexes Dr Adami classified those differences under four headings—(*a*) rate of growth (*b*) date of adolescence (*c*) anatomical age and (*d*) after puberty the composition of the blood—and gave the Committee all the information available on the interrelationship of the internal secretions and the essential and secondary organs of sex for as he said obviously it has a profound bearing upon the problem before the Committee

The lower proportion of red blood corpuscles in women has been established by several workers Dr Adami discussed at some length recent work on the calcium metabolism of the body referring especially to Blair Bell s conclusion that with the onset of puberty the calcium metabolism in the female becomes unstable whereas in the male it remains comparatively constant The committee observes that at that time Blair Bell s views had not been generally accepted by physiologists but it appeared possible that the greater nervous excitability of the feminine sex might be ascribed to a deficiency in calcium If the Committee showed a disposition to study its problem in the dry light of science its recommendations stressed the need for further inquiries rather than the value of results already attained

It must be remembered that the Consultative Committee was not concerned directly with the question of co education Evidence on this question was however received and a digest is given in an appendix The questions considered refer to the relations between boys and girls in mixed schools—whether, for example, boys tend to take a preponderating part in the social life of the school—the danger of overpressing girls and not pushing boys forward sufficiently, the relative failure to meet the individual needs of some girls, and, finally, staffing difficulties These last appear to be the most serious, for the position under which mixed schools are, with some exceptions, under the control

of head masters, does not appear to offer a final solution Women's education has already suffered too much from 'man made' curricula, and a state of things in which all the responsible appointments in secondary education are held by men would not be acceptable to women under present social and political conditions

Originally, in Great Britain, as in the United States, the establishment of mixed secondary schools took place without much premeditation The geographical distribution of these schools in England is curious Buckinghamshire, Derby shire, Durham, Gloucestershire, Hampshire, Lanca shire, Middlesex, Suffolk, Wiltshire, and the West Riding appear to like mixed schools, Kent, London, Northumberland, Staffordshire, Surrey, and Warwickshire appear not to like them Lancashire has thirty three mixed schools and thirty eight boys' schools under the county authority, London has three mixed schools compared to forty boys' schools Mr R F Cholmeley, in his chapter on the boys' day school, contributed to "The Schools of England," edited by Prof Dover Wilson, remarks that the origin of most of these mixed schools is due to convenience, including financial convenience, but he adds that "the interesting thing about them is the growth of a belief in them on educational grounds, and the remarkable success of their work" He regards the growth of the mixed school as one of the most striking developments in day school education The proportion of mixed schools to boys' schools is almost exactly seven to eight, and the number of boys educated therein as two to five

If the growth of the mixed school has been without premeditation, the same may be said of the growth of the girls' secondary school and college The pioneers of women's education saw the nakedness of the land and established new schools and colleges for girls and women, making, at the same time, a reasonable claim to a small share of educational endowments The University of London was an early convert to co *examination*, admitting women to all examinations in 1878, with the significant reservation that "no female graduate of the said University shall be a member of Convocation of the said University, unless and until such Convocation shall have passed a resolution that female graduates be admitted to Convocation" Here we see obtruding the old and difficult question of control, a question of much controversy also at Oxford and Cambridge In London this question has advanced a distinct stage under the new statutes which grant official membership of the Senate to the heads of several women's colleges, an 'ability' accorded to women which will be generally approved, as it seems desirable to ensure the inclusion of women on the governing bodies of universities

In the British universities generally, co education prevails and is unavoidable in the case of subjects studied by a small number of students Oxford, Cambridge, and London, partly owing to their collegiate organisation, present some special problems

The question of medical co education in London has been widely discussed in consequence of the decision of several medical schools in future to exclude women students, a reversal of the policy adopted during the War The usefulness of the Report of the Committee of the Senate of the University of London on this subject is, however, reduced, because it was not found possible to state specifically the reasons which led the medical schools in question to this decision, nor is there any report by the Faculty of Medicine, the advice of which we should have expected the Senate to seek on constitutional grounds The committee states "We are unable to see any valid argument on the merits against the provision of co education in medicine The pre possession of the University is in favour of such co education" Seeing that a large majority of the existing colleges of the University are unisexual, and that seven medical schools have recently expressed a preference for uni sexual education, it is difficult to see on what evidence this 'prepossession' is based Statistics appended to the Report indicate that there is at present no difficulty in women undergraduates obtaining medical education, for whereas in 1920–21 the London School of Medicine for Women had 447 full time students, that number had fallen in 1926–27 to 297 The throwing open of the other medical schools to a 'quota' of women would tend to reduce the success and efficiency of this well organised school for women Apart from this, is not the 'quota' system inherently objectionable? The University would do well to ensure that all special courses, especially those by research workers at the spearhead of knowledge, should be equally available for men and women At the moment, no further action on the part of the University appears to be demanded

Since the publication of the University of London Report, an important opinion on the question of medical co education has been pronounced by Dr Louisa Garrett Anderson, who, at a meeting held at the London School of Medicine for Women on Mar 21, said that a medical school

for women alone had enormous advantages over a co educational school Where women held the professorial chairs, she added, women learned to trust women, but where there was co education it had been found that the most important work was done by men As the Senate Committee, though in its nature a lay committee, did not attempt to quote expert opinions for and against medical co education, this professional opinion by a leading woman doctor comes at a convenient moment and should carry great weight

The general tendency of co education is towards creating large institutions Co educational secondary schools of 5000 pupils are not uncommon in the larger American cities Co-education also facilitates a preponderance of one sex or the other in the teaching staff, whereas with separate schools there is a natural tendency towards an approximate equality In some of our co educational colleges, women do not appear to have obtained a fair proportion of the staff appointments Nor can co education offer much encouragement to specialisation on sex lines which may be desirable in certain subjects, *e g* medicine In higher education, which demands consecration and dedication, the presence of the other sex may act as a distraction Frank R Arnold, in an article "The Mating Season of Co education" (*Scribner's Magazine*, June 1926), refers to "co educational calf love," and argues that the finest type of woman is not likely to be produced by co-educational institutions Such women "need years of meditative acquisition, mental brooding as well as physical, and the fault of co education is that it awakens the mating mother instinct too early"

The Planetesimal Hypothesis

The Two Solar Families the Sun's Children By Prof Thomas Chrowder Chamberlin (University of Chicago Science Series) Pp xxii + 311 (Chicago University of Chicago Press, London Cambridge University Press, 1928) 12*s* 6*d* net

THIS book, which appeared on the author's eighty fifth birthday, and less than two months before his lamented death, is a summary of the well known planetesimal hypothesis of the origin of the solar system which, with the collaboration of Prof F R Moulton, he developed during the last thirty years While the greater part of the book is a restatement of previously published results, some new material is included, and the whole forms a compact and useful account of a hypothesis which, whatever may be its ultimate fate, must take high rank among the generalisations which have stimulated and elucidated geophysical research during this century

The "two solar families" are, in broad terms, the planets and the comets The former class includes the major and minor planets and their satellites, and the latter the chondrulites, comets, and meteorites In "the grey beginning of years," a star passed near the sun, and by tidal action, aided by propulsive forces in the sunspot zones, drew forth a succession of 'bolts' from the near and far sides of the sun These bolts rapidly cooled and were largely disintegrated into a multitude of 'planetesimals' which, in the course of long ages, were gradually reabsorbed by the residual nuclei of the bolts, forming the planets The cometary family owed little, if anything, to the passing star It arose from material ejected from the sun in the manner of the eruptive prominences which are even now frequently observed The hypothesis is extended in an ingenious way, without excess of purely *ad hoc* assumptions, to explain many details of the present solar system Prof Chamberlin's account is not distinguished by marked clearness of expression, but it is in the main free from ambiguity, and the meaning is rarely obscure to the careful reader A bountiful provision of good diagrams and illustrations, and excellent productive work on the part of the publishers, make up a worthy conclusion to the author's long series of contributions to geology and allied sciences

The publication of the book has seemed to Prof Moulton a fitting occasion to direct attention to certain matters connected with the planetesimal hypothesis and its reception among astronomers He has accordingly issued a pamphlet entitled "The Planetesimal Hypothesis," in which several important points are raised It is made up of two distinct parts, which may be described succinctly as constructive and destructive They are not entirely unrelated, for the instruments forged in the former are used as weapons in the latter, and in fact were clearly designed for that end, but the division is nevertheless a convenient one

In the constructive part a sharp line is drawn between hypotheses of the Laplace type and those of the planetesimal type "The gap between these different genera of intellectual constructions is as profound as that between different genera of living organisms, and as difficult to bridge" The characteristics of the genera are described by examples instead of specific statements, but it is clear that the typical feature of the former is the idea that the evolution of each cosmic mass is free from extraneous influences and consequently can be traced out rigorously

from a few fundamental principles in a statement of great simplicity If intra atomic sources of energy are ignored, these hypotheses require a cosmic time scale of tens of millions of years Hypotheses of the planetesimal type, on the other hand, regard the stars as mutually related objects, the evolution of each depending in part upon the others The simplicity of the former type does not exist, so that some parts of the planetesimal hypothesis may be accepted and others rejected The time scale required here is of the order of thousands of millions of years

Later in the pamphlet another classification is advanced which distinguishes hypotheses which are expressible in formulæ from those which are not Prof Moulton well explains the character of a 'formula' or 'law of Nature,' and although he does not actually state that this classification is a restatement of the former one, it may fairly be inferred that that is so The Laplacian theory and the Genesis account of creation are cited as examples of hypotheses expressible by simple formulæ, and the planetesimal hypothesis as an example of the other kind

So much for the constructive side of the pamphlet, now for the destructive side This originates in the relations between the planetesimal hypothesis and the views of Sir James Jeans and Dr Harold Jeffreys on the origin of the solar system, which are mainly contained in ' Problems of Cosmogony and Stellar Dynamics " (1919) of the former and " The Earth " (1924) of the latter The theories of Jeans and Jeffreys both invoke a passing star to produce the planets from the sun by tidal action, but the conditions of the process and the subsequent developments differ in the two theories, as does each of them from the planetesimal hypothesis

Prof Moulton first protests against the frequent ascription of the assumption of a passing star, and the proof of the invalidity of Laplace's hypothesis, to Jeans instead of to the prior work of Chamberlin and himself Further, although the time scale of cosmic processes has lately been greatly extended through the discovery that intra atomic energy might be available for stellar radiation, no adequate acknowledgment has been made of the fact that this possibility was urged by Chamberlin nearly thirty years ago

This, however, is not all Prof Moulton goes on to denounce the methods of Jeans and Jeffreys in claiming credit by implication for Chamberlin's work He complains that these writers give the impression that the idea of a passing star and allied conceptions are mainly due to British workers, and that they do not fairly indicate the date of birth of the planetesimal hypothesis, so that priority is likely to be wrongly assigned He gives a history of the development of that hypothesis and compares it with the later work of Jeans and Jeffreys, concluding that the 'tidal theory' of these writers is identical in every essential concept with the planetesimal hypothesis and that the former is an abortive attempt to put the latter into a formula

From the point of view of scientific history and general principles, Prof Moulton's pamphlet has much importance and some justification There seems to be no doubt that due acknowledgment has not generally been given to the work of Prof Chamberlin and himself with respect to the assumption of a passing star, the criticism of Laplace's hypothesis, and the realisation of the factors determining the cosmic time scale The planetesimal hypothesis is clearly entitled to very serious consideration, yet it has rarely been considered seriously outside the works of the authors themselves It is easy to find reasons for this, but difficult to find excuses We hope the pamphlet will make it unnecessary to look for them in the future

Very pertinent also are Prof Moulton's remarks concerning the significance of formulæ A mathematical statement undeniably carries with it an air of authenticity which does not usually accompany general descriptions, although the latter may involve greater imaginative insight and approach more nearly to the actual happenings of Nature In the attempt to reconstruct cosmic history, the inquirer may be actuated by either of two motives he may believe that something actually occurred in pre human times, and seek to discover what it was, or he may be concerned to weld together observed phenomena into a consistent logical scheme, and introduce the past as a useful parameter without necessarily assigning to it the dignity (or indignity) of actuality Usually, perhaps always, the two motives are mixed, but on the whole the former predominates in the descriptive, non mathematical theorist, and the latter in the mathematical physicist So long as our knowledge is partial, at least, the two motives will urge the inquirer along diverging paths We are glad that Prof Moulton has had the courage to insist that one is not inevitably more valid than the other

Having made so clear a distinction, however, Prof Moulton most surprisingly fails to preserve it, and as a result we have his vigorous criticism of Jeans and Jeffreys which his own general principles, if properly applied, would discredit The starting-point and sole sanction of the attack is the assump-

tion that the 'tidal theory' of these writers is merely a vain attempt to formularise the planetesimal hypothesis and consequently is separated by a profound gap from hypotheses of the Laplace type It is difficult to understand how such an assumption could be made, for there could scarcely be a more typical example of the Laplacian type of hypothesis than the tidal theory It has, in common with the planetesimal hypothesis, the assumption of a passing star as the origin of the whole process, but the sub sequent development is so profoundly different in the two lines of thought that the bodies which give the name to the hypothesis of Chamberlin and Moulton do not exist in that of Jeans and Jeffreys

Extracts from prefaces will perhaps make this clear Jeans writes "The present essay is primarily an attempt to follow up a line of research initiated by Laplace and Maclaurin, and extended in various directions by Roche, Lord Kelvin, Jacobi, Poincaré, and Sir G Darwin" Prof Moulton's examples of the Laplacian type of hypothesis are the works of Laplace, Helmholtz, Sir G Darwin, and Lord Kelvin Jeans continues When a firm theoretical framework had been constructed, it seemed permissible and proper to try to fit the facts of observational astronomy into their places" Chamberlin, on the other hand, was led to theoretical discussion by a desire to explain geological facts "We may make the vestiges of the genetic events serve as our guide All the peculiarities of the planetary system should serve as system pointers to the true interpretation"

Again, Jeffreys writes "Quantitative comparison of theory with fact has always been the main object of the book" Clearly it is the 'formula' type of theory that is attempted here

Prof Moulton's attack on Jeffreys's 'tactics' is regrettable and, it appears to us, without justification It is unfortunate that Jeffreys does not give a specific date to Chamberlin and Moulton's work, but the character of his discussion of it is not fairly indicated in the pamphlet After very favourable mention in Chap ii it is discussed in an appendix of seven pages beginning "The Planetesimal Hypothesis was historically the parent of the Tidal Theory It was invented by T C Chamberlin and F R Moulton in the early years of the present century, and detailed accounts of it may be found in" (three sources) Since Prof Chamberlin gives 19 references to original papers on the hypothesis, excluding its exposition in books, Jeffreys's date is perhaps as specific a one as could conveniently be given, and should certainly mislead no one in the matter of priority The historical importance of the hypothesis is again emphasised at the end of the appendix

We are convinced that Prof Moulton's charge of national jealousy is unfounded, and the foregoing quotations appear to us to be strong evidence on this point It will nevertheless be appropriate to examine the matter more generally An analysis of the personal references in the indexes of the books here considered reveals the following percentage figures

	References to		
	English Writers	American Writers	Others.
Chamberlin	13 1	65 6	21 3
Jeans	22 8	37 9	39 3
Jeffreys	58 6	16 8	24 6

Prof Chamberlin s book has been included not in order to criticise his neglect of non American work, but to show the inevitability of an apparently undue emphasis on the work of one s own country men in any original investigation We do not complain of Prof Chamberlin s tactics we go to his book for an account of the planetesimal hypothesis which was indisputably made in America But we do think that Sir James Jeans and Dr Jeffreys are entitled to a similar consideration Their theories are as original as Prof Chamberlin's, and we hope that Prof Moulton's just objection to a general neglect of Prof Chamberlin's work will no longer be weakened by an unjust attack on the work of others

H D

The Study of Corals

Catalogue of the Madreporarian Corals in the British Museum (Natural History) Vol 7 *A Monograph of the recent Meandroid Astræidæ* By Prof George Matthai Pp v + 288 + 72 plates (London British Museum (Natural History), 1928) n p

THE existing corals are the most unsatisfactory group of the animal kingdom from a systematic point of view They are accursed in that they have supposed ancestors and relations so far back as the early Cambrian, the play of stratigraphers, who care not for life Their most prominent feature is an exo skeleton of carbonate of lime, which is neither for protection nor for muscular attachments, both of which are reflected in those of vertebrates and arthropods There are radiating plates (septa) from centres, over which lie the mouths (stomodœa) of the anemones (polyps) that are seated upon them Other structures are central columns (columella) and surrounding walls, all free edges toothed perhaps, and the skeleton (corallum) goes on perpetually thickening so long as the

anemones live There is immense variation in the size and height of septal teeth, and the septa vary in length, height, and thickness, as do all other structures, in correlation with rapidity of growth, with incidence of light, with water movements, and so on Systematy becomes worse in 'colonial or many mouthed or polyped forms, for these show in addition, more clearly correlated with environment, variation in the position and rate of production of new polyps such as to give wide differences in the coralla All modern reef builders have algæ living and reproducing within their polyps, and these we judge to be the most important factor in their nutrition They, like the chlorophyll in the tree, may produce vast modifications in the growth form of their host

Yet modern corals must be classified for the sake of the palæontologists who have to make their deductions as to the fossil species from the analogous living forms, if for no other people About half a century ago their skeletons were all we really knew They were supposed to be internal before von Koch found them to be formations or precipitations outside the animals Then the anatomy of the polyps was partially cleared up by von Koch and by von Heider Fowler, Bourne and Duerden amongst others, while Wayland Vaughan, by his studies on both living and fossil corals, greatly enriched our knowledge The barrenness and inadequacy of any systematic study based on corallum alone was made clear Yet, to bring conviction, the attempt had to be made to bring order out of confusion on the old lines, and the Natural History Museum issued six catalogues dealing with eight genera Brooks and Bernard made confusion worse confounded The latter never examined scientifically even a single coral polyp, and yet stated that their skeletons 'follow the growth of the polyps closely ' He was unable to determine his species and adopted a geographical arrangement, for example, enumerating twenty four forms, which he termed Porites Fiji Island, 1–24 ", growth forms are correlated with localities rather than with environments These catalogues were misfortunes, sheer waste of money, which could have been avoided if any member of the Museum staff had been sent to any coral reef for six months' study of the living forms

It was at this stage that Prof Matthai commenced his researches eighteen years ago He made a profound study of polyps and coralla together, specialising on the massive, many polyped Astræidæ, some of which have separate seats for each polyp, separate corallites, while others have meandering valleys with many stomodœa Of the former he had more than eight hundred specimens in the collections at Cambridge, and he examined the polyps of seventy five of these by sections He also worked over the collections of Glasgow and of most of the European capitals, in which he found 590 colonies His results (*Trans Linn Soc*, **17**, 1914) reduced the described species by three-quarters, and he showed that, once the polyp form of a species was determined, the species could be recognised by coralla alone Hermaphroditism was seen to be a common phenomenon, and fission of the polyps by division through their stomodœa was proved not to exist, thus upsetting a main character in all former classification

Prof Matthai then extended his researches to the reefs of the West Indies and, *en route*, examined many of the Dana and other types in the United States His Colony Formation in Astræid Corals ' (*Phil Trans R.S*, 1926) sets out two modes of polyp budding, inside and outside their tentacular rings The extratentacular budding corals have only a single stomodœum within each circle of tentacles, whereas the intratentacular are di , tri , or poly stomodœal, the stomodœa joined to each other by either one or two couples of mesenteries The foundation of the long meandering valleys of the brain corals was made clear *Hydnophora* is the extreme case its monticules are isolated bits of corallite walls, while the polyp surface between has vast numbers of stomodœa, the 'colony' being really a single poly stomodœal anemone, seated on a coral base of complicated plates and walls

The systematic examination of the vallied Astræidæ was the test required for these results The Cambridge collections, both of these and of the genera previously examined by Matthai, were given to the Natural History Museum, together with all sections, etc , for permanent reference The Museum at once offered to print a catalogue, and this has now appeared, with such a wealth of illustration that, be the system correct or not, we have a mass of information from which any subsequent researcher may conveniently start Matthai's services were given under considerable personal sacrifice, but he should be satisfied with the results, which reflect the highest possible credit on himself and on the Indian Educational Service to which he belongs This is a strong statement, but I confess that I was sceptical as to the application of his theoretical paper to systematy As a result, I have been testing his methods and conclusions as to the species of his corals off and on, since I first learnt them, more than a year ago I

find they work with comparative ease, and I have no advantage over any other systematist save a very limited acquaintance with corals as living organisms

The secret expounded by Matthai is first to study the polyps, none of which have directive mesenteries, to determine how they form fresh mouths, and this gives the clue to valley formation, etc He finds the same methods in quite diverse colonies, these form a genus to be further divided into species on other anatomical characters The mesenteries joining stomodœa, the varied forms of nematocysts, and the number of principal mesenteries are some of the accessory characters of his polyp key Those chosen for the skeleton key are septal margins toothed or not septa thick or thin columella present or absent, and lamellar, dense or trabecular, etc these unfortunately, bear a minimal relationship to the growth methods of the polyps, with which the mesenteries of the first key are concerned Each key will help the systematist to name, but the corallum key gives no clue to the phylogeny of the group, as to which the author rightly speculates The interesting fact appears that of the 28 genera described, 16 are confined to the Indo Pacific and 12 to the Atlantic their centres respectively in the East and West Indies Ten of the genera are monotypic, while 10 others have 2 species each Of the more abundant brain corals the Indo Pacific *Cœloria* has 4 species (2 new) in place of 16, and the Atlantic *Mœandrina* 3 in place of 28 *Mussa* of the West Indies—it is a pity that Matthai could not obtain polyps—is stated to be monotypic, whereas its supposed Indo-Pacific forms are placed in three species of *Lobophyllia*, which would be easier to follow were their numerous figures less scattered in the plates

In conclusion, we congratulate the Directors and the Keepers of the Natural History Museum that have been concerned on their bravery and scientific acumen in recommending the publication of this catalogue, after six previous quite disastrous volumes The refiguring by photographic methods of a large number of 'type specimens' in many museums is of immense value, and only made possible by the recognition that science is international This shows a healthy spirit in zoological science, as does the co operation of directors and collectors with a real worker On the whole, I am disposed to consider that the method here sketched is almost the last word so far as the anatomy of 'wild' species is concerned, and for the next advance I look to experiment and to a study of the whole physiology of coral polyps, particularly to that of corallum formation That many species are adapted to wide changes in salinity, in temperature, in currents, in mud content of the water, in light, in phosphate content (especially in connexion with the commensal algæ), etc, is certain All these are felt by the living polyps and are reflected in the growth of large colonies We must know here more about our living beasts before we study further their systematy

J Stanley Gardiner

The Origins of European Culture

The Most Ancient East the Oriental Prelude to European Prehistory By Prof V Gordon Childe Pp xiv + 258 + 24 plates (London Kegan Paul and Co, Ltd, 1928) 15s net

A NEW book by Prof V Gordon Childe is always welcomed by students and the volume under notice has special value as it carries the history of European cultures as described in his Dawn of European Civilization" (1925) to their origins in the ancient East for the whole chronology of prehistoric Europe ultimately rests on synchronisms with the historical cultures of Babylonia and Egypt The book begins with a reconstruction of the culture of the then thickly populated pleasant grass lands of northern Africa and southern Asia of late palæolithic times Firm ground is reached in the description of the culture recently found at Badaria, south of the Fayum Culturally, the immigrant Badarians were a whole stage removed from the savagery of the Capsian hunters, they had mastered all the arts that are usually termed neolithic, and in addition they were acquainted with copper The Badarians may have been autochthonous in the Nile valley or somewhat farther east, the modern Hadendoa appear to have relations with this ancient stock They were the founders of Egyptian agriculture Later, the first pre dynastic culture arose in Upper Egypt from this basis and an infiltration of Getulian elements from the west

The First Dynasty of Babylon can be fixed at 2196 B C, but long before this there are written records of kings of various cities that date back to an event termed the Flood, and even earlier The First Dynasty of Ur dates from before 3000 B C, and belonging to a period some 500 years earlier are the royal tombs excavated by Mr C L Woolley Those who have seen his exhibitions in the British Museum will recognise that this very rich and mature civilisation must have had a long history behind it Gordon Childe discusses the character and affinities of the first and second prediluvial

cultures, the former is mainly revealed from excavations at Susa (S I) and at al'Ubaid, the latter is that of Susa II and of other sites

As we have the first account in book form of the Badarian culture, so also we have that of the Indus civilisation We find thanks to work of Sir John Marshall on the now impoverished banks of the Indus a brilliant civilisation in touch at once with the prediluvial villages of the Iranian plateau and the nascent city states of Babylonia, and the Arabian Sea was ploughed by dhows freighted with the stuffs of Sindh consigned to Babylonian river towns Thus the civilisation of Sindh was ahead of that of Sumer About 3000 B C a catastrophe over took the cities of the Indus basin Gordon Childe thinks it is a legitimate deduction that the rôle of the maritime peoples of Arabia was to act as intermediaries between Egypt Mesopotamia and India

This book should be of definite interest to the non specialist reader as it is pleasantly written copiously illustrated and will enable him to place in their historical setting the discoveries that are continually being noticed in the daily Press

A C H

Our Bookshelf

Morpheus or the Future of Sleep By Prof D F Fraser Harris (To day and To morrow Series) Pp 94 (London Kegan Paul and Co, Ltd New York E P Dutton and Co, 1928) 2*s* 6*d* net

A NUMBER of eminent men of science have contri buted to the admirable series to which this little book belongs, and success has attended their efforts varying with their ability to cast aside professional restraints and speak their adventurous and un guarded minds If the unsophisticated reader is willing to add Dr Fraser Harris's name to the list, it will be for reasons which are unfortunately con cealed from the specialist No subject could offer a greater opportunity for daring and ingenious speculation founded in scientific fact but Dr Fraser Harris prefers to follow (rather lamely) the story of the journals On p 11 expectation is aroused by the statement that comparatively few people could tell us exactly what it is that makes us sleepy and finally permits us to go to sleep' Gall, Mosso, Pupin, Claparède, Ramon y Cajal, Duval, Howell, Coriat, and Pavlov did not claim to do more than suggest tentatively, and while the author gives some account of their work, it is for the most part shorn of those honest doubts and reservations which somehow constitute a real contribution to the subject Finally, he takes refuge in that disastrous propensity of physiologists confronted with conflicting streams of evidence, the 'omnibus' theory Thus we have the absurdity 'types' of sleep (p 26) Par ticularly it is confusing to see Pavlov taken into the omnibus First among physiologists he seems to have broken with the earlier inactivity theories completely There is still the problem of sleep

Some serious errors are made The granules of Nissl are scarcely 'rod like' and they certainly are not to be found in the nuclei of nerve cells in any circumstances, as Dr Fraser Harris implies (p 25) The dream does not appear to have a very respectable biological ancestry if all we can say is that we are entitled to assume that certain animals for instance the dog, can dream" For many animals the dream is a most important pro tective mechanism The speech centres in the frontal lobes does some injustice to several workers and it is to be doubted whether insistence upon the hallucinatory character of dream images is to be commended even in a popular work Several passages suggest that Dr Fraser Harris has not observed the manias associated with low blood pressure Whether there seems no reason to doubt that information is conveyed telepathic ally or directly to the brain without having been communicated through any of the sleeper's organs of sense (p 77) is a matter of opinion as is also the statement that some dreams are the expres sion of ancestral memories is an attractive theory' (p 78)

The future of sleep is discussed in sixteen pages Evidently its security will depend largely upon social and political agitation for the suppression of its prolific modern enemies

Elements of Alternating Currents and Alternating Current Apparatus By Prof J L Beaver Second edition Pp xiii + 393 (New York, London and Toronto Longmans Green and Co, Ltd 1928) 18*s* net

THIS book is written mainly for the benefit of those commencing the study of alternating currents The numerical examples are numerous and a very fair attempt has been made to explain away the difficulties which every one experiences in studying the subject For those who have not the benefit of a teacher numerous references are given to papers and other text books where fuller explana tions will be found Some of these papers, as for example the *Bulletins* of the General Electric Company of America cannot easily be obtained on the eastern side of the Atlantic The nomen clature used is mainly that standardised in America Capacity is called capacitance and a condenser is sometimes called a 'capacitor' Possibly this is to prevent confusion with a steam condenser, which is quite a different device It has long been thought desirable by electricians to standardise the termination 'or' to designate a piece of apparatus But the difficulties in the way seem insuperable Arrestor, startor, and divertor are coming into use, but exciter, damper, and feeder still have the 'er' termination

Naturally, in an elementary book it is difficult, if not impossible, to state the theorems rigorously and to give their limitations We think, however, that a word of warning might have been added on

p 166 to the formula given for eddy current losses On p 44 it is misleading to state that the 'convex surface' of a conductor carries the high-frequency current In a concentric main with high-frequency currents the current nearly all flows near the concave surface of the outer conductor, the current near its convex surface being almost negligible On p 107 the method of representing a vector by a complex number is attributed to Dr Kennelly Mathematicians usually attribute it to J R Argand (1806), but it seems to have been previously used by Gauss and Wessel (1797)

L'Industria chimico metallurgica del solfato di rame e le miscele cupriche funghicide ed anticrittogamiche Per E Crivelli Pp viii + 321 (Milano Ulrico Hoepli, 1928) 35 lire

This is an interesting book, which can be heartily recommended to makers or users of copper sulphate, to all chemists, and, as regards some sections of it, to the general reader

Part 1 deals with the development of the blue vitriol industry and with its marketing, methods of analysis and properties, and contains also a detailed description of its manufacture, including treatment of by products In Part 2, the metallurgy of copper, in so far as it concerns the manufacture of the sulphate, is considered, and in Part 3, such subjects as its physiological effects, its mode of action in lime–copper sulphate pastes, its uses as an anticryptogam, and various minor applications, are discussed

The book has been carefully written and, although the information given must be almost exhaustive, is far from being a mere compilation, the material being dealt with in a logical and readable manner To the majority of readers, probably the most interesting portions of the book are those of Part 3, in which the available experimental data concerning the effects of copper salts on animals and plants are subjected to critical examination

No index is provided, but this lack is largely compensated for by the table of contents A few minor misprints occur, and the first logarithm given on page 52 for $CuSO_4$ is actually that of the pentahydrated salt The printing is of the usual high Hoepli standard

An Atlas of Economic Geography (Text and Maps) By John Bartholomew and Prof L W Lyde Third edition, revised and enlarged in co operation with M R Shackleton Pp xciii + 74 (London Oxford University Press, 1928) 8*s* 6*d* net

This is more than an atlas of economic geography, for the text runs to nearly a hundred pages, and besides explaining the maps, adds a great deal of useful geographical matter It is full of ideas, and points out many striking geographical correlations Prof Lyde is responsible for the whole of the text The number of coloured maps is slightly reduced from the original edition, but two dozen black and white distributional maps have been added In these, as in the coloured maps, the technique is excellent and the standard of accuracy is high Minor changes might be made in the map of religions and of commercial development, and it is to be hoped that in the next edition the colour division of the races of man may be abandoned Another improvement in a most useful work would be the re introduction of the maps of seasonal distribution of rainfall and of languages of commerce

Stage A Geometry By R W M Gibbs (Black's Mathematical Series) Pp viii + 109 (London A and C Black, Ltd, 1927) 2*s*

All teachers will recognise the importance of the Mathematical Association's Report on "The Teaching of Geometry in Schools," and the value of Mr Gibbs's work lies in his successful attempt to provide a suitable text book to cover Stage A as recommended in the Report The arrangement of subject matter and the selection of examples show that the author is used to the practical difficulties of approaching the subject of geometry for the first time

Emphasis is naturally laid on the experimental aspect, and field work, and what is sometimes known as 'boy scout geometry,' are well treated In addition to general ideas on mensuration, including Pythagoras's theorem, the book concludes with introductions to symmetry, loci, and similar figures This volume should form an excellent stepping stone to the other stages, deductive and systematising, mentioned in the Report

H D A

Volumetric Glassware By Verney Stott (Books on Glass and Glass Technology) Pp 232 (London H F and G Witherby, 1928) 20*s* net

This work comes as a wholesome corrective to those trustful chemists and physicists who are tempted to accept their volumetric instruments even with a modicum of faith The author emphasises the importance of quality and accuracy in volumetric glassware, and his book is intended for manufacturers and users of such apparatus Various common types, including measuring flasks, graduated cylinders, pipettes and burettes, are treated in detail, and a description is given of the processes of marking and graduating Other essential subjects, such as units of volume, calibration tables, and the effect of apparatus errors on results, are also adequately treated The book, which contains numerous illustrations and tables, can be recommended to all who are concerned with volumetric analysis and similar work

School Researches in Heat By C W Knight Pupil's Book Pp ii + 96 1*s* 3*d* Teacher's Handbook Pp 80 1*s* 6*d* net (London George Philip and Son, Ltd, Liverpool Philip, Son and Nephew, Ltd, n.d)

Little books which follow the author's method of teaching heat to an elementary standard by means of questions and answers They are good in their way, though somehow the spontaneity which the method demands seems dulled by the formality of print

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Nervous Impulse in *Mimosa pudica*

Is the conduction of the excitatory impulse in the plant essentially similar to that of the nervous impulse in the animal? This problem is of great theoretical interest. In his "Nervous Mechanism of Plants" (1926), Bose states that the intercommunication and interaction between more or less distant organs in the plant are brought about, as in the animal, "in two different ways—by translocation of matter and by transmission of motion. The first is effected by the *slow* movement of fluid carrying chemical substances in solution, such as occurs in the circulation of sap; the second by the *rapid* propagation of protoplasmic excitation such as the nervous impulse in the animal." In his presidential address at the Indian Science Congress, Lahore (1927), Bose makes his position perfectly clear by the statement that in physiological investigations the inquirer is primarily concerned *with the function of the organ and not with its outward form*. In support of this he adduces the case of insectivorous plants (*Drosera*, *Dionæa*, and *Nepenthes*) which are universally acknowledged to possess digestive organs, in spite of the fact that the organs are very different in appearance from those of the more complex animal. The employment of the same term for these plant and animal reactions is justified by the fact that the function of digestion is performed by similar processes in both: the solution of organic food material by a glandular secretion, and the subsequent absorption of the dissolved product.

The plant-world offers a unique opportunity for the study of the gradual evolution of a simple and primitive organ into one of greater complexity. In regard to the nervous function, it is to be remembered that the conducting tissue in the animal kingdom itself exhibits wide variation from the simpler type as in the Medusæ to the more complex in the higher animals. The conducting tissue of the plant would naturally be expected to be much simpler in structure, and as a matter of fact it is very different in appearance from the nerve of the higher animals. The question to be decided is whether or not the process of conduction of excitation is similar in the two cases (being usually detectable by the contractile movement of the terminal motor organ).

There are several physiological tests of a crucial character by which the nature of the transmission of the impulse in *Mimosa* can be ascertained, whether it is dependent upon a movement of sap, or is a conduction of protoplasmic excitation. Sir J. C. Bose has been kind enough to offer me every facility for working in his Research Institute at Calcutta, and an account of the following experiments on transmission of excitation in *Mimosa* will doubtless be of interest to readers of NATURE. It may be stated that the series of experiments which I repeated were accomplished without a single failure. Limitation of space allows me to describe only one typical example of each series.

The experiments were carried out in winter (January 1929). Though the physiological condition of *Mimosa* was not so favourable as in summer, yet I encountered no difficulty in obtaining the following results in a green house (temp. 30° C.) in which the sunlight was uniformly diffused by glass thinly coated with white paint.

EXPERIMENTAL SERIES 1. *Discriminative Polar Action of Electric Current in Excitation.*—In an animal nerve, a feeble electric current initiates excitation at the cathodic point at 'make' (there being no excitation at the anode); the transmitted excitation is detected by the twitch of the terminal muscle.

In the parallel experiment with *Mimosa*, I made suitable electric connexions with two opposite petioles at a distance of 20 mm. from the motile pulvinus. When the point on the right petiole was made the cathode, an excitatory impulse was generated which, travelling against the direction of the normal transpiration current reached the pulvinus and caused the fall of the leaf after an interval of 1.5 sec. Making allowance for the latent period of the pulvinus, the velocity of transmission of excitation in this winter specimen was found to be 14.3 mm. per second. Reversal of the direction of the current by a Pohl commutator caused cathodic stimulation of the left petiole, resulting in the fall of that leaf.

Similar results were obtained with the secondary petiole of a leaf, in which the propagation of the excitatory impulse is exhibited by the upward closure of the sensitive leaflets (Fig. 1). Bose found that the

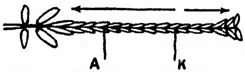

FIG. 1.—Effect of feeble current. *K*, cathode; excitation transmitted across feeble anode *A*. Arrows indicate directions of propagation of impulse which ultimately causes closure of all leaflets to right and left.

velocity of transmission in *thin* petioles is very much higher, being 100-350 mm. per second. My results fully confirm this.

It will be noted (1) that the impulse was transmitted in the complete absence of any hydromechanical disturbance; (2) that excitation was originated and conducted without any wound which might have induced the secretion of some hypothetical stimulant which could be translocated by the movement of sap; (3) that the direction of transmission of impulse was inwards, against the direction of the normal transpiration current; (4) that the speed of transmission was incomparably higher than that of the slow movement of sap; and (5) that the characteristic polar action of the current which initiates nervous impulse in the animal also caused an excitatory impulse in the plant.

EXPERIMENTAL SERIES 2. *Arrest of Conduction by Anodic Block.*—With feeble current, the impulse in the animal nerve is transmitted across the anode; but with a stronger current, the depression of conductivity at or near the anode is so great that the impulse is arrested by an anodic block.

In *Mimosa*, parallel effects can easily be demonstrated in the secondary petiole, conduction taking place in both directions as in the nerve. On starting a feeble current (1.4 microamperes), the cathodic excitation at *K* was transmitted (Fig. 1) to the right and to the left (across the feeble anode). The experiment was repeated with a stronger current (3.5 microamperes), the impulse initiated at the cathode *K'* was now transmitted to the extreme right end of the secondary petiole, whilst the impulse to the left was

completely arrested at A' by the depression of conductivity caused by the stronger anode (Fig 2)

EXPERIMENTAL SERIES 3. *The Reflex Arc*—The phenomenon of the reflex arc is well known in the animal, where the afferent or ingoing impulse due to peripheral stimulation is reflected at a centre and is transmitted along a new path as an efferent or out going impulse

It is very surprising that exactly parallel effects are observable in *Mimosa* Peripheral stimulation of the

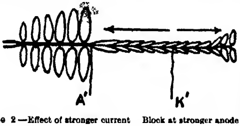

FIG 2—Effect of stronger current Block at stronger anode *A*

secondary petiole (1) at *S*, by tetanising electric shock of moderate intensity (Fig 3), gives rise to an ingoing or afferent impulse, which reaches the pulvinus and causes the fall of the leaf After a short while, the existence of an efferent or outgoing impulse is detected by the serial fall, from base towards apex, of the leaflets on the secondary petiole (2) There is a marked difference between the velocities of the ingoing afferent and of the outgoing efferent impulses Bose found it to be about seven times greater In the experiments which I carried out I found it to be six to eight times quicker

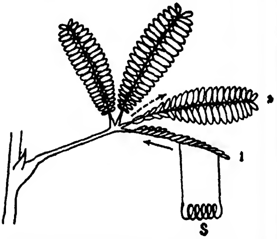

FIG 3—The reflex arc Peripheral stimulation of secondary petiole 1 at *S* causes afferent impulse (continuous arrow) which after reflection at pulvinus gives rise to efferent impulse (dotted arrow) in secondary petiole 2

As all the characteristic effects of the transmitted impulse in *Mimosa* are in every way similar to those of the nervous impulse in the animal, the most natural inference is that the process of transmission is of the same nature in both Physiologists will therefore be inclined to agree with Bose's conclusion, that if the impulse be called 'nervous' in the animal, there is equal reason for applying the same term in the case of the plant

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Jan 29

Growth-gradients and the Development of Animal Form

D'ARCY THOMPSON in his "Growth and Form," Chapter xi, deals lucidly with the properties of logarithmic spirals, and the reasons for their frequent occurrence in organisms He points out that for them to arise, (1) parts of the growing edge must be growing at different rates, the growth rates of any two points on the edge preserving a constant ratio of growth rates for so long as a regular logarithmic spiral is produced, (2) the growth rate must fall off more or less steadily from one end of the growing surface to the other, (3) the products of growth must be laid on as so much dead matter, or at least matter incapable of further growth. In his own words (p 500) the logarithmic spiral form of an organic structure can be explained "if we presuppose that the increments of growth take place at a constant angle to the growing surface, but more rapidly at the 'outer edge' than at [the 'inner edge'], and that this difference of velocity maintains a constant ratio Let us also assume that the whole structure is rigid, the new accretions solidifying as soon as they are laid on"

It is, I think, worth pointing out that this and the type of growth which Champy (C Champy, "Sexualité et Hormones," Doin, Paris, 1924) and I (J S Huxley, *Biol Zentralblatt*, Bd 47, p 151, 1927) have called heterogonic (in which the size relations of organs x and y can be represented by the equation $y = bx^k$) are both special cases of the same phenomenon namely, of constant differential growth ratios in different regions of the organism The sole difference is that in logarithmic spiral growth the increments produced take no further part in growth, but are locked up as so much rigid structure, while in heterogonic growth the increments are added to the mass of living tissue capable of continued growth The difference is similar to that between two sets of sums of money growing at different rates of simple interest and at different rates of compound interest respectively

There is a further interesting similarity between the two types of differential growth In logarithmic spiral growth, the growth rates fall off more or less evenly from one margin of the growing surface to the other I have succeeded in showing (*l c* and unpublished work) that in markedly heterogonic organs such as crustacean chelæ (*Uca*, *Maia*, *Homarus*, *Eupagurus*, various prawns, etc) the most rapid growth rate is that of the penultimate joint, the growth rates of the other joints falling off regularly as the body is approached Similar facts appear to be true for the limbs of ungulates, according to my friend Mr J C Hammond, and the abdomen of female spider crabs (M E Shaw, *Brit J Exp Biol*, 6, 145, 1928) When, on the other hand, growth is isogonic, all the parts (joints of female chela, *Uca*, *Maia*, joints of male abdomen, *Inachus*) grow at the same rate

As I previously pointed out, and as has been stressed by Pearsall (W H Pearsall, "Growth Studies" 6. "On the Relative Sizes of Growing Plant Organs," *Ann Botany*, vol 41, No 163, pp 549 556, 1927) in his analysis of similar heterogonic relations between the parts of plants, heterogony is really the simplest type of differential growth, occurring, namely, when the ratio of two growth rates remains constant over long periods It is interesting to find that one of the other most generally distributed modes of growth, that in the form of a logarithmic spiral, is deducible from the same principle. Various shells depart slightly from the strict logarithmic spiral, and various disharmonically growing organs depart slightly from the accurate heterogonic formula. But this does not obscure the basic nature of the differential growth-ratio

It would further seem to be a general principle that when two regions of markedly different growth rate exist in an organ or region, there is a graded change of growth rate in the intermediate space The bio chemical basis of such graded differences in growth rate should be interesting to investigate

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April 3

Difference between the Absorption and the Raman Spectrum

Several investigators have recently stated that in many cases Raman lines are found which do not correspond with infra red absorption frequencies (Carelli, Pringsheim, and Rosen, *Zs f Phys*, 51, p 511, 1928 Czerny, *ibid*, 53, p 317, 1929 McLennan and McLeod, Nature, 123, p 160, 1929 Ellis, *ibid*, p 205 Rasetti, *ibid*, 205 R W Wood, *ibid*, p 279, and others) Several authors state this as contrary to the theoretical expectations The purpose of this note is to direct attention to the fact that the above mentioned phenomena, far from being a contradiction to the theory, really furnish a very good proof for the validity of the Kramers' theory of dispersion, which includes the theory of the Raman effect

If we consider two levels A_1 and A_2 we have absorption if the transition coefficient a_{12} is different from zero But this coefficient does not enter at all into the expression which determines, according to Kramers and Heisenberg, the intensity of the Raman line From the fact that this coefficient is zero, one cannot therefore conclude that the corresponding Raman line must be absent and vice versa The intensity of the Raman lines is determined by the transition coefficients to levels B_1, B_2, B_3, etc, which can combine with both A_1 and A_2 The Raman fre quency can therefore always be regarded as the difference between the frequencies of two lines, one of which must be an absorption line, and this in agree ment with the results of Rasetti and especially with those of McLennan and McLeod A very good ex ample is also furnished by the beautiful results of Wood in hydrochloric acid Wood finds that the so called missing line occurs with great intensity in the modified radiation, whereas the real lines of the ab sorption band are faint and doubtful

This is exactly what we must expect For let us consider a hydrochloric acid molecule in a definite rotational state j, and confine ourselves to the different vibrational and rotational states of the normal molecule Then there is, on account of the selection rule for j, not a single state which can combine at the same time with the j and the $j \pm 1$ rotational state, or differently expressed, an absorption line of the HCl band cannot be written as the difference of two other lines and therefore ought not to occur in the Raman spectrum On the other hand, every transition in which the rotational quantum number j does not change or varies two units (the *vibrational* quantum number varies from zero to one for all lines under consideration) can be written in more than one way as a difference of two line frequencies We must, therefore, expect these frequencies in the Raman spectrum rather than the frequencies of the absorption band The transitions in which j does not change give the 'missing line' and are forbidden as absorption lines Raman lines corresponding to transitions $j \longrightarrow j \pm 2$ must be expected very much weaker, as they are distinct lines for different values of j with twice the distance of the absorption lines, whereas all the $j \longrightarrow j$ transitions correspond to lines which coincide on the place of the zero line and give rise, therefore, to one intensive line This seems to be in agreement with Wood's observations Rotational transitions $j \longrightarrow j + 2$ of the expected type seem to have been observed by McLennan and McLeod in H_2 If also the ultra-violet absorption bands, of which nothing is known, are taken into account, these considerations have to be modi fied a little But from the general structure of the molecular terms it can be deduced that, for diatomic molecules at least, an absorption line never can be expected as a Raman line Apparent exceptions to this rule find their explanation in an unresolved fine structure

With the same considerations one sees that scattering in sodium vapour ought to give a shift corresponding with the forbidden line $1s - 2s$ rather than with the absorption line $1s - 2p$

Since the above was written, I have seen the letter by Langer in Nature of Mar 9, p 345, in which he makes essentially the same observation But as he treats only a rather complex example and proceeds according to somewhat different lines of reasoning, the present note is perhaps not superfluous It ought to be mentioned also that Schrödinger's theory of dispersion in its original form is, contrary to Langer's statement, not in agreement with the facts, whereas the present form of quantum mechanics (Dirac) leads exactly to Kramers and Heisenberg's results

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Holland, Mar 8

Breeding Habits of the Greenland Whale

Very little is known about the breeding habits of the Greenland whale In the Greenland Sea, according to the log books of Scoresby Sen, females with calves with them were seldom seen except in spring, west of Spitsbergen, north of latitude 78° or 79°, and in the end of July off the Greenland coast Young whales, with whalebone 2 3 feet long—the smallest which are seen by themselves—were also seldom seen except in a high latitude west of Spitsbergen in spring Where they go to in the summer months is not hard to understand as my father says, "the old females with the younger whales of both sexes bury them selves in the polar ice, north of latitude 80°, after (or before) the end of June, where no ship can follow them, retreating in the autumn southwards as the ice makes in the north" (Scottish Fishery Board, Seventh Annual Report, part 3, p 366)

A female with a calf with it became a rare sight in the Greenland Sea, in twelve voyages (1791–1798, 1801, 1817, 1820, and 1822) Scoresby Sen saw one only on sixteen dates, namely, west of Spitsbergen, and north of 78° or 79° in April once, in May eleven times, and in June once, and off Greenland twice, both times at the end of July, in latitude 70°, in the forty four voyages he was master (1849–1891 and 1893) my father only saw about a dozen (*l c*, p 365), and in his last twenty voyages only one (in the end of July in latitude 73° off the Greenland Coast), and in the log books of twenty nine other voyages made in the period 1872–1908 not a single instance is recorded

There are few facts to go on, but it seems safe to infer from what the Scoresbys and from what Eschricht and Reinhardt say, that at least some of the young are produced in the spring Even less is known about where they produce, at one time they entered the inlets of western Spitsbergen in the summer months, and Sir Sidney Harmer (*Proc Linn Soc*, May 1928, p 89) connects their visits with the function of

parturition and looks on the unmolested use of the Spitsbergen bays as of importance to them, this, however, seems unlikely for the following reasons

1 In the spring, when some, possibly all the whales of the species, as Scoresby suggests, produce their young, the sheltered parts of the west Spitsbergen inlets are usually still covered with the ice that forms in the winter months

2 In Davis Strait, according to Eschricht and Reinhardt, the corresponding visits of the species to the inlets of west Greenland synchronised with the proximity of the pack ice to the coast and were not connected with parturition

3 In the Greenland Sea and in the waters west of Spitsbergen (the 'Greenland' of the old whalers), contrary to what Sir Sidney Harmer states (*l c*, p 59), the fishery continued productive for long after the whales ceased to enter the inlets and bays, in the ten seasons (1679–1688) (thirty or forty years after) the 'Greenland' fleet of the Dutch, numbering about 190 ships, alone captured 10,019 whales (Scoresby, vol 2, p 156), and so late as 1814 in the same waters 76 English and Scotch 'Greenland' ships alone captured 1413 in a single season (*ibidem*, p 121)

Sir Sidney Harmer seems to imply that the females with calves with them not only entered the Spitsbergen bays, but also were destroyed in these situations in large numbers by the early whalers, this, again, seems unlikely, for in the seventeenth century the whalers do not appear to have arrived at Spitsbergen until the end of May, and after the time at which the females with calves with them usually disappear amongst the impenetrable polar ice, a separation of the sexes seems to take place in the summer months, and it seems more likely that the whales that entered the Spitsbergen bays and were killed by the early whalers (if they all belonged to this species) belonged mostly to the male sex ROBERT W GRAY

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Nuclear Levels and Artificial Disintegration

THE existence of quasi discrete levels in the atomic nucleus has been suggested by Dr Condon and myself in a paper in the *Physical Review*, in which the nuclear theory first outlined in NATURE, Sept 22, 1928 (vol 122, p 439), is pursued These quasi discrete levels are narrow ranges of energy for which the amplitude of the ψ functions inside the nucleus is large compared with the amplitude outside In a very interesting letter in NATURE of Nov 24, 1928, G Gamow, who in other respects had arrived quite independently at the same basic ideas with regard to the nucleus (*Z f Phys*, **51**, 204), gave a résumé of various applications, including that of artificial disintegration, a detailed account of which has since appeared (*Z f Phys*, **52**, 510) Considering the intensities of the transmitted and reflected waves, he inquires how the probability of penetration into the nucleus will fall off with decreasing velocity of the incident α particle, treating the nucleus as a simple potential barrier, he naturally finds that the probability shows a steady decrease

The object of the present note is to direct attention to the possibility of resonance phenomena if we take into account the solutions of the Schrodinger equation which for certain ranges of energy give ψ functions the amplitude of which inside the nucleus is large compared with that outside For this seems to indicate that variation of the velocity of the incident α particle may be accompanied by an enormous fluctuation in the probability of penetration when the energy approaches and enters the range of energy corresponding to one of the possible quasi discrete levels A systematic examination of thin films of various elements might disclose such a fluctuation, if the experimental difficulties can be overcome No resonance effect would be possible if we had discrete levels, indefinitely narrow, the absence of any genuine quantisation in the nucleus is due to the fact that the potential energy of the α or β particle must be taken as tending to zero when distant from the nucleus, in contrast to the method of Laue, it would seem, then, that the *Eigenwerte* of which he speaks (*Zeit f Phys*, **52**, pp 731 2) do not exist, but that all energies are possible (a continuous spectrum)

The transmission of particles through a simple potential barrier resembles transmission of light at a single reflecting surface, in that the coefficient falls off steadily with varying wave length But it is of course well known that the addition of a second reflecting surface (as in Fabry and Perot parallel plates) causes large fluctuations in the transmission, those wave lengths being favoured for which standing waves are possible, that is, when the thickness of the film is equal to one or more half wave lengths This provides a crude analogy to the case of the nuclear ψ functions, one half wave length for a free swift α particle being about $2\ 5 \times 10^{-13}$ cm Possibly the discovery by Rutherford and Chadwick of an energy giving minimum intensity of reflection of α rays at 135° (*Phil Mag*, **50**, p 900, 1925) was a resonance phenomenon

The application of the quantum mechanics may modify the interpretation, but seems to throw no light on the origin of the discrepancies between the results obtained at Cambridge and Vienna Although, for example, the argument in favour of a theoretical minimum range for the ejected H particles has lost its validity, since they may now escape through the potential barrier instead of having to fall through the entire repulsive field as had been previously argued by Chadwick (*Phil Mag*, **2**, pp 1073 4 1926), the experimental observation remains unaffected

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The Average 'Forward' Momentum of Photoelectrons

IT is well known that the emission of photoelectrons by X rays is not symmetrically distributed about the plane normal to the rays, the photoelectrons possessing an average momentum in the forward direction I showed about a year ago (NATURE, Jan 28, 1928, p 134) that, contrary to general supposition, the average forward momentum μ, of a photoelectron is, according to experiment, not equal to the momentum $h\nu/c$ of an incident quantum, but is appreciably greater Sommerfeld in his recently published book, "Atombau und Spektrallinien, Wellenmechanischer Ergänzungsband" (1929), has treated the problem theoretically by the wave mechanics, and the purpose of the present note is to show the remarkable agreement of Sommerfeld's result with experiment

Sommerfeld (p 218) finds that the probability $P(\phi)\ d\phi$ of emission of a photoelectron at an angle between ϕ and $\phi + d\phi$ with the incident radiation is proportional to

$$\{1 + \tfrac{1}{2}\sqrt{(h\nu/mc^2)} \cos \phi\} \sin^3 \phi \ d\phi \qquad (1)$$

It follows from this that the average momentum of a photoelectron is

$$\mu_{theor} = 1\ 44(h\nu/c) \qquad (2)$$

The value found experimentally by Nuttall Barlow

and myself (*ibid.*, also *Proc. Roy. Soc.*, December, 1928) is

$$\mu_{expt} = 1.40(h\nu/c) \qquad (3)$$

If $\overline{\cos\phi}$ denotes the mean cosine of ϕ, θ the 'bipartition' angle (defined by $\int_0^\theta P(\phi)d\phi = \int_\theta^\pi P(\phi)d\phi$), and ρ the ratio of the forward to the backward emission, then according to (1)

$$2\,\overline{\cos\phi}/\beta = 1.44,\ 2\cos\theta/\beta = 1.80,$$
$$2(\rho - 1)/(\rho + 1)\beta = 2.70 \qquad (4)$$

β being the velocity of the photoelectron relative to that of light. The observed values of these quantities are 1.4, 1.8, and 2.6 respectively. Thus there is very good agreement with experiment whatever quantity is chosen as a measure of the asymmetry.

Formula (1) expresses the asymmetry to a first approximation, and is applicable only if $(h\nu/mc^2)$ and $(J/h\nu)$, where J is the binding energy of the electron, are small. These conditions are adequately satisfied in the cases investigated in the above experiments, namely, photoelectrons produced in nitrogen and oxygen by X-rays of wave-length 0.6 A.

Mention should be made of P. Auger's recent experiments in which he finds $\mu = 1.30(h\nu/c)$ for argon and $\lambda = 0.21$ A., and $\mu = 1.30(h\nu/c)$ for argon and $\lambda = 0.71$ A. (*Comptes rendus*, Dec. 10, 1928). These results and (3) show that $\mu/(h\nu/c)$, equals σ say, is approximately independent of λ and J as is required by (2). As mentioned in the previous paragraph, formula (1) represents the asymmetry only to a first approximation, and theoretically there should be a small variation of σ with λ and J which may account for the slightly smaller values of σ found by Auger. Auger's earlier observations (*Jour. d. Phys.*, February 1927) quoted by Sommerfeld correspond to $\sigma \simeq 0.9$, but this is refuted by his recent experiments.

Sommerfeld states that his calculated asymmetry is 9/5 times that expected on simple light quantum theory, but if we consider the mean momentum of the photoelectrons instead of the bipartition angle as Sommerfeld does, the ratio is $\frac{4}{5} \times \frac{9}{5} = 1.44$, as expressed by (2). The difference arises from different ways of regarding the simple light quantum theory and is unimportant.

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Cambridge, Mar. 6.

Anomalous Terms in the Spectrum of Doubly Ionised Lead

IN the course of an analysis of the spectrum of doubly ionised lead (Pb III), the results of which will shortly be published, some combinations of more than usual interest to spectroscopists were found to occur. These combinations involve the anomalous terms arising from the state of the doubly ionised atom of lead when both the two remaining valence electrons occupy $6p$ orbits. The terms to be expected for this state of the atom are 6^3P_{012}, $6^1\bar{D}_2$, and $6^1\bar{S}_0$.

As is well known, the rules for the transitions between states of an atom with two valence electrons are that $\Delta l_1 = 0$, $\Delta l_2 = \pm 1$, or $\Delta l_1 = \pm 1$, $\Delta l_2 = \pm 2$ where l_1 and l_2 are the azimuthal quantum numbers of the two electrons. Accordingly transitions from the $6p6p$ state to the following low lying states may be expected to occur: $6p6d$, $6p6s$, $6d6f$, $6s6f$. The second and fourth of these states lead to the important low lying terms 6^3P_{012}, 6^1P_1, 6^3F_{234}, and 6^1F_3. Applying the inner quantum number selection rules, we obtain between these terms and the anomalous 6^1D_2 term the following possible combinations: $6^3P_{12} - 6^1\bar{D}_2$, $6^1P_1 - 6^1\bar{D}_2$, $6^1\bar{D}_2 - 6^3F_{23}$, and $6^1\bar{D}_2 - 6^1F_3$.

All these combinations have been found. $\lambda\lambda$995.75, 1165.05 form the doublet $6^3P_{12} - 6^1\bar{D}_2$, and $\lambda\lambda$4004.16, 3925.23 the doublet $6^1\bar{D}_2 - 6^3F_{23}$, $\lambda\lambda$1439.42, 3832.83 are $6^1P_1 - 6^1\bar{D}_2$ and $6^1\bar{D}_2 - 6^1F_3$ respectively. The measures below 2000 A. are by Dr. R. J. Lang and are expressed in λI.A. vac., and those above 2000 A. are by myself and are expressed in λI.A. air. The source in each case was the vacuum spark.

It may be recalled that Sawyer (*Jour. Opt. Soc. America*, 13, p. 431, 1926) in the case of the arc spectrum of zinc, classified a doublet as arising from combinations between the 4^3P_{12} terms and an anomalous 4^1D_2 term. But so far as I am aware there have as yet been no cases recorded of the appearance of $F\bar{D}$ combinations for two valence electron systems. For this reason the FD lines mentioned above are of peculiar interest.

Of the three terms 6^3P_{012}, only $6^3\bar{P}_1$ has been found. This apparent absence of the 6^3P_{02} terms is in agreement with the known facts regarding the corresponding terms of Zn I, Ca I, and Hg I. The line λ2868.16 is also worthy of notice, as it appears to be $6^3P_1 - 6^3F_2$, a combination which is also to be expected. It is of course the only combination between the F terms and the $^3P_1$ term permitted by the inner quantum number transition rules. The $6^1\bar{S}_0$ term has not yet been determined. Unfortunately, only the combinations $6^3P_1 - 6^1\bar{S}_0$ and $6^1P_1 - 6^1\bar{S}_0$ are to be expected. There is at least one likely pair having the $6^3P_1 - 6^1P_1$ separation, but the absence of confirmatory evidence in the form of further combinations makes it difficult to come to a definite decision.

The first spark spectrum of thallium (Tl II), which is analogous to that of Pb III, has also been investigated and the $6^3P_{12} - 6^1D_2$ and $6^1P_1 - 6^1D_2$ lines have been found. The FD combinations would give rise to lines lying far in the infra-red, and consequently have not yet been identified.

STANLEY SMITH.

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Edmonton, Canada, Mar. 4.

Agricultural Education

THE leading article in NATURE of Mar. 9 on "Land and Industry" indicates an interesting possibility of dealing with the unquestionably important problem of establishing a 'land interest' among non-agricultural citizens. It might be worth while to consider the relation of agricultural education to this problem.

No one who has seriously considered the problem of national agricultural prosperity is likely to deny that the interest of the city and urban public is a primarily important factor. Nor is he likely to deny that those of us who are responsible for developing interest in agriculture have practically ignored the non-agriculturist. The activities of agricultural education have increased enormously during the last quarter of a century, but it seems to have been tacitly assumed throughout its developments that agricultural education is essentially and almost exclusively a provision for agriculturists, and that for the most part the proper people to exercise primary control over it are agriculturists and not educationists.

I have an ever increasing conviction (confirmed to no small extent by Mr. C. G. T. Morison's presidential address to the Agriculture Section of the British Association in 1927) that agricultural education can render a far greater service to the country if it will remove its delimitations and endeavour to attract

others than intended agriculturists If our university departments of agriculture would open their doors wider and offer courses for laymen as well as for agriculturists, and regard such courses as equally important, the ultimate development of a 'land interest' would surely be considerable If men and women who are destined to teach in our schools or to take a part in public affairs had the opportunity to read agriculture during a university course, the ultimate indirect effect on our national agriculture might be as great as the present direct effect of agricultural education

So far as its direct influence on farming practice is concerned, agricultural education is normally associated with some such phrase as "the application of science to farming" When, however, one considers the two great groups of factors which alone can create or alter an economic condition—scientific facts and philosophical outlook—one is left with more than a suspicion that the greater defect in our agriculture is not in science but in philosophy Great as is the scope for bringing more scientific knowledge to the farm, the limiting factor to-day is interest in farming and in the phenomena of the farm Without slackening its efforts to find scientific solutions of specific farm problems, agricultural education can greatly increase its service to the community by giving more attention to what after all is the essence of education, namely, the development and propagation of an interest in its subject matter

This suggestion in no way implies a criticism of the work of those agriculturists who, for the most part, control the administration of agricultural education in Great Britain The suggestion is rather that their work needs to be balanced by purely educational aspects of the teaching of agriculture in order that agricultural education may be developed with properly distributed emphasis and with greater usefulness to the community N M COMBER

The University, Leeds

The Occurrence of Ergosterol in Phytosterols

THE interest which has been aroused by the discovery that ergosterol is converted into vitamin D on irradiation has led us to consider its possible mode of formation in the vegetable kingdom

In this connexion some interesting facts arise from the recent work of Bonstedt (*Zeitschr für physiol Chem*, **176**, 269, 1928) on γ sitosterol, first detected by Anderson and Shriner in corn oil (*Jour Am Chem Soc*, **48**, 2976, 1926) This investigator has prepared a number of derivatives of this sterol, and a comparison of their physical properties with those of the isomeric derivatives in the ergosterol series reveals, as shown in the following table, a remarkable similarity

Formula	Substance	m p	$(\alpha)D$	Authority
$C_{27}H_{48}O$	γ-sitostanol	143 4°	+21°	Bonstedt (*loc cit*)
		144-5°	+18°	Anderson Shriner (*loc cit*)
	allo α ergostanol	144 5°	+16	Reindel and Walter, *Annalen* 460, 212 1928
$C_{29}H_{50}O_2$	γ-sitostanol acetate	144 5°	+12°	Bonstedt
	γ-sitostanol acetate	143°	+9°	Anderson, Shriner
	allo-α-ergostanol acetate	145	+6°	Reindel, Walter
$C_{27}H_{46}O$	γ-sitostanone	163°	+38°	Bonstedt
	allo α ergostanone	164°		Reindel, Walter
$C_{27}H_{48}$	γ-sitostane	87°	+20°	Bonstedt
	allo-α-ergostane	84 5°	+17°	Reindel, Walter

Reindel and Walter (*loc cit*) have shown that there is no depression of melting point on mixing γ sitostanol acetate with allo α ergostanol acetate, but infer from the difference in specific rotation that the two substances are not identical This contention we feel is open to question, for, as we have already pointed out (Heilbron, Morton, and Sexton, *Jour Chem Soc*, p 47, 1928), owing to the complex nature of the sterol molecule, the possibilities of racemisation at one or more of the asymmetric centres during the operations involved in their preparation cannot be excluded

The common and probably general association of dihydrositosterol with sitosterol in vegetable oils (*see* Bonstedt, *loc cit*, Anderson *et alia*, *Jour Amer Chem Soc*, **48**, 2972 *et seq*, 1926) suggests its genesis by a reduction process Similarly, as there is every reason to believe that ergosterol is also present in all phytosterols (Heilbron, Kamm, and Morton, *Biochem Jour*, **21**, 1279, 1927), we venture to suggest with all reserve that concurrent with its reduction to dihydrositosterol (sitostanol), oxidation of sitosterol (possibly γ sitosterol) to ergosterol occurs

The fact that neither of the two known tetrahydro ergosterols (ergostenols) is identical with the isomeric γ sitosterol is in no way remarkable It has been established that ergosterol contains an ethenoid linkage which resists hydrogenation under conditions which suffice to convert γ sitosterol into the fully saturated derivative, consequently, in the conversion of ergosterol to its tetrahydro derivative, the ethenoid linkage remaining must be in a different position from that present in γ sitosterol The suggested identity therefore only reveals itself in the fully saturated products

It is hoped that work which is now in progress in these laboratories may throw additional light on this important problem I M HEILBRON W A SEXTON

The University, Liverpool

Transmutation of the Lighter Elements in Stars

THE formula given by Gamow (*Zeits f Phys*, **52**, p 512, 1928), for the probability that an α particle will penetrate the nucleus of an atom with which it collides, can be readily adapted to the case of proton impacts These have only half the charge of an α particle, and for the same energy twice the velocity, so that under conditions approaching thermodynamical equilibrium they have an enormously greater penetrating power We have investigated the possibility that in the interior of stars the process should actually occur with appreciable frequency, and we find that for the heaviest elements the probability is extremely small For the lightest, however, we obtain an average life varying roughly from 10 seconds for helium to 100 years for carbon in a fairly typical case The protons that are most effective, when their number is taken into account, are those with from three to four times the most probable velocity of the Maxwell distribution

We cannot well estimate the probability that a proton which has entered a nucleus will anchor itself there by radiating, but there are some indications that it may be high In that case there is an obvious possibility of gradually building somewhat heavier elements out of the lightest ones, this possibility is much improved if *electrons* can also penetrate the nucleus, but the calculation of this case has not yet proved practicable It seems, however, a plausible assumption We may then expect that the isotope Be^8 will be one of the products, this is probably unstable (it does not occur on the earth), and will then almost certainly break up into two helium nuclei, so that the supply of helium does not become exhausted, and the process

is limited only by the amount of hydrogen The theory obviously contains several uncertain hypotheses, but a calculation of the amount of energy that would be set free by the process gives quite the right order of magnitude In addition, the process fulfils the requirement of Eddington that its probability should increase very rapidly with the temperature at about 40 million degrees, and can also fulfil his requirement that it should contain a 'delay period' which is not dependent on temperature or pressure It thus seems possible that the stellar energy has a source in this method of element building which the wave mechanics has opened up to us But there are so many astro physical difficulties that we hesitate to express a definite opinion, more especially as it is difficult to see how the heaviest elements can be formed by this means at all

A full account of the investigation will appear shortly in the *Zeitschrift fur Physik* It would seem worth while to investigate the effect of fast protons on light elements in the laboratory, and experiments along these lines are contemplated

R D'E ATKINSON
F G HOUTERMANS

Physikal Institut der Techn Hochschule,
Berlin Charlottenburg,
Mar 22

Internal Absorption of γ-rays

FOUR years ago (NATURE, 115, 13, 86, 1925), one of us estimated the internal absorption of the γ rays of radium D and the fraction of the atoms emitting γ rays Due to an oversight and, in the latter case, an arithmetical error, both estimations are incorrect They have recently been re calculated in the following manner

The relative ionisations produced by the β rays of radium E (in equilibrium with the radium D), and the soft and hard γ rays were measured in an electroscope, the walls of which consisted of paper coated with graphite and, after correction, were found to be 24,000, 40, and 2 6 respectively Assuming that the energy in a beam of X or γ rays is proportional to the total ionisa tion produced in air, the respective energies in the three types of rays were found to be proportional to 1500, 13, and 23 As the respective average energies of single rays are 350,000, 12,000, and 46,700 electron volts, we find that for the disintegration of 43 atoms of radium E or radium D, 11 atoms emit a soft γ ray (L radiation) and 5 atoms a hard γ ray No allow ance, however, has as yet been made for the fact that β rays are ejected by the hard γ rays from M and N levels (the consequent M and N radiations would not be observed in our experiments) Curtiss estimates that the intensity of the β rays ejected by the hard γ rays from the M and N levels is 70 per cent that from the L levels, so that, assuming the number of hard γ rays absorbed to be proportional to these intensities, 8 atoms emit M and N radiations

We arrive, therefore, at the following figures Out of 43 atoms disintegrating, 24 atoms emit γ rays Of these 24 γ rays, 19 suffer internal absorption It seems probable that, in the case of all substances, only a fraction of the atoms emit γ rays after a β ray dis integration This should be taken into account in estimating times of emission of γ rays

A further set of experiments was carried out to determine if there were any β rays emitted from radium E with energy of the order 2,000,000 electron volts The method used may be of interest and is given below An electroscope was placed on top of the poles of an electromagnet, which produced an average field of 1250 gauss The active material was 10 cm below the bottom of the electroscope Sufficient material was placed beneath the electroscope to cut off secondary β rays produced by γ rays, and, directly over the active material, absorption sheets which cut down β rays of energy 2,000,000 volts until the issuing rays had a value of $H R < 6000$ Such rays would be deflected from the electroscope by the magnetic field No difference was found between the electroscope readings with and without magnetic fields Allowing for the difficulty of measuring small differences, we estimate that less than one atom in 25,000 emits a β ray of energy 2,000,000 volts, and possibly none at all

J A GRAY
A J O'LEARY

Queen's University, Kingston,
Feb 7

Diœcism in *Ranunculus acris*

MR R O WHYTE's letter in NATURE of Mar 16, p 413 on the cytological aspect of the hitherto little noticed peculiar form of the common acrid buttercup, stimulates me to make some general remarks respect ing it

I first made its acquaintance in the spring of 1923 near my home in Cumberland, and sent specimens to the Linnean Society of London They were exhibited at the meeting held on June 21 (*Proc Linn Soc*, p 50, 1923) Through lack of time, I believe, they were not discussed I then approached a leading authority on the British flora, Dr Claridge Druce, who kindly replied to the effect that this form was strange to him He incorporated it in his "Plant Notes" for 1923 (*Report*, Bot Exchange Club, p 24, 1923), with an extract from my letter, naming it *Ranunculus acris* L var, sub var, or forma *minutiflorus*, Druce

Finding that Mr Marsden Jones was working on the genetics of the genus *Ranunculus* I sent specimens to him, and he was not long in reporting to me the occur rence of the same in his own neighbourhood, Potterne, Wilts I am glad to see that he has not only taken up the genetics of it, but also has prevailed upon Mr Whyte to work out the cytological side—a piece of research which promises to shed light on the origin of unisexual from hermaphrodite flowers

It is curious that this 'female' form of *Ranunculus acris* has not excited attention previously None of the British floras consulted refer to it Since it came under my notice for the first time in 1923, I have seen it every subsequent season in fair abundance in my own neighbourhood Apparently it is a general associate of the ordinary form of this buttercup What exactly is its significance in the bionomics of the species it is difficult to say One might hazard the view, tempting but not altogether probable, that *Ranunculus acris* is in the incipient stage from her maphroditism to gynodiœcism

Though no exact calculation as to the frequency of this 'female' form among the ordinary type in my neighbourhood has been made, one per cent might be a possible estimate, though of the extreme cases with stamens as mere rudiments this might be a consider able overstatement The extreme form is very notice able on account of the much smaller size of the petals Moving such 'female' plants to the garden has not changed the size or character of the flowers in subse quent seasons, so that the reduced nature of the corolla and the abortion of the stamens are apparently not due to poverty of soil or other adverse conditions No difference in vegetative characters can be detected between the ordinary and the 'female' plants The latter appear just as vigorous in growth

JOHN PARKIN

Blaithwaite, Wigton,
Cumberland, Mar 20

Excitation of Mercury Vapour by the Resonance Line

IN supplement to my letter in NATURE of Mar 30, p 488, under the above title, I have now made a series of experiments, starting with mercury resonance radiation under typical conditions at room temperature As the temperature of the mercury is progressively raised, and a rapid stream of vapour is generated, the secondary source, originally symmetrical on either side of the primary beam, begins gradually to elongate on the down stream side, until finally it is wholly on this side, being traceable for a distance of about 3 cm down stream

Although this result is unexpected, and contrary to prevailing views, the photographic evidence is very clear I hope to publish the photographs in due course RAYLEIGH

Terling Place, Chelmsford,
Essex, Mar 30

Invisible Oxide Films on Metals

THE well known work of Evans on the passivity of metals has led to the conclusion that oxidation can occur at room temperature on copper and iron, giving a film which is too thin to show interference colours In his lecture to the American Institute of Mining and Metallurgical Engineers (1929) he has remarked that it is logical to suppose that the oxide film has a real existence before any interference tints are shown Evans quotes the work of Freundlich, Patscheke, and Zocher (*Z physikal Chem*, 128, 321, 1927), who have made pure metallic iron mirrors from iron carbonyl They find distinct changes in the reflecting power when air is admitted, showing the formation of oxide films of the order of 10^{-7} cm in thickness

Muller and Koenigsberger (*Phys Zeit*, vol 5, p 413, 1904) have found that there is little difference in the reflecting powers of iron in the active and passive states In my experiments at temperatures at which the iron interference colours are formed very slowly, there is distinct evidence from the reflecting power of surfaces that there is an oxide film present before there is any evidence of interference colours visible to the eye (cf *Proc Roy Soc*, A, vol 117, p 376, 1928)

In the early stages of oxidation the reflecting power of iron, nickel, and copper becomes somewhat smaller over the whole range of the spectrum, but slightly more so at the violet end of the spectrum than in the red, showing the existence of an absorption maximum far away in the ultra violet region

During the study of the spectrophotometry of the growth of sulphide films on metallic copper, evidence was obtained strongly supporting Evans's conclusions of the formation of an oxide film at room temperatures If reduced copper be attacked with a mixture of one volume of hydrogen sulphide and five volumes of air, two complete colour sequences are produced in a few minutes, if, however, the copper surface be left exposed to air for some hours, and then hydrogen sulphide and air admitted, the interference colours are developed very slowly indeed Only one colour sequence could be observed during a whole day's exposure In addition there was a general dulling of the colours so formed

Heating the metal to 300° C in a nitrogen vacuum of 10^{-5} mm did not remove the film Hence there is clear evidence in support of the conclusion that a thin film of oxide is formed on copper merely on exposure to air at ordinary temperatures

F HURN CONSTABLE

St John's College,
Cambridge

Solutions and Heat Engines

THE nature of osmotic pressure is a matter of such great importance both to chemists and to physiologists that I must again crave space to reply to the remarks of the reviewer in NATURE of Mar 23, p 445

In justification of his, or van 't Hoff's, account of osmotic pressure, he points to the description in my book of what would happen if a mixture of two gases at atmospheric pressure in a rigid chamber was separated by a rigid septum, permeable by only one of the two gases, from pure gas of the same kind as could permeate, and at the initial pressure of the mixture The pure gas would pass into the mixture, the pressure of which would rise until the pressure of the penetrating gas was the same in the mixture as outside of it The gas which penetrates corresponds to the solvent in a solution, and the non penetrating gas to the solute, while the extra pressure developed in the mixture might be held to correspond to osmotic pressure May I point out, however, that this extra pressure is due to solvent and not to solute molecules There is thus in the phenomena no way of escape from the dilemma for van 't Hoff's theory which I indicated in my letter Van 't Hoff's assumption that osmotic pressure is due to extra bombardment pressure of solute molecules is both unintelligible physically and inconsistent with the facts as revealed by the experiments of Morse and Lord Berkeley

The algebraical statement on page 25 of my book, to which the reviewer objects, is, I maintain, perfectly correct, and I am well content to leave the judgment as to its correctness with readers of the book

J S HALDANE

Cherwell, Oxford, Mar 23

I WILL add only one short note to what I have said Consider two cases (1) One atmosphere of hydrogen on each side of the septum and no nitrogen The osmotic pressure is zero (2) Two atmospheres of nitrogen inside the chamber and again one atmosphere of hydrogen on each side This also is an equilibrium case and the osmotic pressure is TWO atmospheres By what wild theory is this attributed to the ONE atmosphere of hydrogen ! THE REVIEWER

Science and Mathematics

THE sentence italicised in the following from a work published in 1877, seems to have anticipated the views of relativists by half a century "Any kabalist well acquainted with the Pythagorean system of numerals and geometry can demonstrate that the metaphysical views of Plato were based upon the strictest mathematical principles 'True mathematics,' says the *Magicon*, 'is something with which all higher sciences are connected, common mathematics is but a deceitful phantasmagoria whose much praised infallibility only arises from this—that materials, conditions, and references are made its foundation' As long as exact science confines its observations to physical conditions and proceeds by the Aristotelian method it certainly cannot fail But, ***notwithstanding that the world of matter is boundless for us, it still is finite***, and thus materialism will turn forever in this vitiated circle, unable to soar higher than the circumference will permit The cosmological theory of numerals which Pythagoras learned from the Egyptian hierophants is alone able to reconcile the two units, 'matter' and 'spirit,' and cause each to demonstrate the other mathematically" —"Isis Unveiled," i 7 W W L

Evolution in its Course

ONE of the most persistent plaints of the anti evolutionist is that the biologist has failed to demonstrate to the satisfaction of the unbeliever the actual occurrence of evolution in the present day world The criticism is difficult to meet, for, apart from the blind eye which the critic is apt to turn to the well meaning efforts of the biologist, evolution is a slow process not readily to be caught in its stride Even amongst biologists themselves there has been a tendency in recent years to look askance at the work of the systematist, and to lean upon the experiments of the laboratory as the only sure test of biological processes

It is well to be reminded, therefore, that the last decade has seen a great advance in the technique of the systematist, and that the advance has afforded new ground for the examination of the problem of evolution in natural conditions In the old days an account of the bird life of a limited area in California would have meant little more than the bare records of a local list of the bird inhabitants, but, under the new analysis, Mr Joseph Grinnell's " Distributional Summation of the Ornithology of Lower California " (*Univ California Pub Zool*, vol 32, No 1, 1928, pp 1 300) becomes a plea for the recognition of evolution in its course

Two factors have made for this progress in method The first is the attention given to the discernment of minute differences in form, and it is sufficient answer to those who cavil at the difficulties of the determination of sub species, that in these barely recognisable differences lie the critical, formative stages, which may lead to the development of easily distinguished species The second factor lies in the attempt to associate these minute differences of sub species with the peculiar conditions of environment in which each is situated, in an endeavour to discover something of the causes and essential conditions of the differentiation

The general results of the analysis of the bird life of California show, then, the progress of evolution in Nature, as closely as the examination of static conditions can be expected to interpret a continuous process They do not reveal anything that is particularly novel or unexpected, but the fact that they are based upon an intensity of examination and detail of comparison such as was unavailable to Darwin or Wallace, lends them new weight and authority

In the first place, there is evidence of gradual differentiation Among the numerous races of Californian birds, examples can be selected showing practically every appreciable stage in differentiation, from neighbouring stocks showing departures from a type so slight that they can be appreciated only when a long series of individuals is averaged, to full-blooded species, sharply distinct, no longer crossing with related species, judging from the absence of wild hybrids

In the second place, the differentiation, that is, the variational move towards species, is not everywhere a uniform process The inequality may be associated with several definite characters of the environment Thus, in many of the groups of wide distribution, the amount of difference shown by the geographical races varies directly with the degree of spatial separation Take the clear case of the group including the California linnet (*Carpodacus*) The group extends over the mainland, a distance north and south of some eight hundred miles, and in that space has three recognisable subspecies But on Los Coronados Islands, only seven miles off shore, there is another race, appreciably but not constantly or conspicuously different Forty miles from the nearest mainland, on the San Benito Islands, there are greater and fairly constant differences from the birds of the mainland, and on Guadalupe Island, 135 miles away, the differences are so great and constant that the form there is designated a full species

The differences themselves are significant The Guadalupe birds are distinguished by their larger size, longer legs, relatively shorter wings, and shorter keel of sternum — indications of a loss of wing power, which suggest a step towards the flightlessness of some other birds on remote Pacific islands

Even a slight water barrier may be influential as an effective form of isolation, preventing free interbreeding of birds from neighbouring places Although there are no apparent barriers in the whole extent of the mainland of lower California, long distance has had the same isolating effect, allowing differentiation in remote stocks despite commingling over adjacent territory

Other cases of the influence of isolation, such as that shown by the spotted towhee (*Pipilo maculatus*), could be cited, they illustrate the fact that closely similar races in a series are not situated " within the same differentiation area, nor yet in remote differentiation areas, but in separate and adjacent differentiation areas "

In the third place, it becomes clear that environment may have an effect which, no matter that the subjects of its influence are different, results in a remarkably similar set of results A very peculiar climatic condition exists between the crest of the Sierra San Pedro Mártir and the Pacific, where a region of meagre rainfall has a high atmospheric humidity—a humid desert Various birds in this region, as different as flycatchers, finches, and woodpeckers, show similar modifications, especially marked in deeper coloration, certain proportions of wing and tail, lesser size of bill, and so on Subjection of very different stocks to the same peculiar set of critically important conditions has brought parallel modifications in certain functions and structures

This suggests that the inherited variations have not been random, but have been directed So far so good, but the author goes on to say that subspecific characters are therefore to be regarded, either intrinsically in themselves or in their linkages, as of *worthy* sorts in the racial struggle for existence —not, ordinarily, indifferent or useless ones Here he seems to travel in advance of his facts, for it has

yet to be shown that the common characters which have been induced by a peculiar environment in so many different kinds of birds can have an equal survival value to each of these birds of habits so different On the facts put thus, the safer assumption would seem to be that similar conditions induce a similar organic reaction irrespective of 'worthiness' or 'unworthiness'

After all, unworthiness in the evolutionary sense is not likely to survive in hard competition with worthiness, and Mr Grinnell finally reaches a Darwinian conclusion "The accumulating evidence of the field naturalist is bringing conviction that the incipient species in nature, the subspecies, owes its origin to a process, on a vast scale, of trial, discard, and preservation, of individuals, and of groups of individuals comprising populations, which populations from generation to generation are thereby rendered more nearly adjusted to such environments as they can endure at all But environments themselves never stabilize, they are changing, proliferating, evolving continually A balanced state of perfect adaptation of the organism can never be attained, but only continually approached, such approach being forced, under penalty of extinction"

J R

Physical Foundations of Chemical Theory

NO task is more difficult for the chemist of the present day than that of trying to keep abreast with those advances in atomic physics which affect him so closely that he cannot ignore (even if he cannot hope fully to understand) them Sidgwick's book on "The Electronic Theory of Valency," which was reviewed at length in these columns last year (April 7, 1928, vol 121, p 527), provided a partial solution of the problem from the chemist's point of view, but the brief monograph of Lessheim and Samuel referred to below [1] may be regarded as a complementary contribution of unrivalled value from the physical side The professional spectroscopist does not often realise how difficult his subject can be made for the lay reader, and it is a common experience, even when reading books or lectures of a semi popular character, to be pulled up short by technical or controversial details of which no explanation is given or attempted

In the more leisurely days of the past, there was usually ample time for one fundamental idea to be grasped before attention was distracted by the next new development Progress was then made by the orderly passing of the ball from one three quarter back to another, until it was safely placed behind the goal, and in due course 'converted' from speculation or hypothesis to theory Now, however, the ball progresses amid the confusion of a wild 'forward' rush, in which the casual onlooker can only occasionally get a glimpse of the ball, and has but little chance to observe the effects of individual play, whilst even the professional reporter is in danger of overlooking essential points in the game Thus, whereas Bohr's 'principal quantum number' n had a sufficient start to secure universal acceptance, and has retained its strictly integral character, it has been followed in the works of subsequent authors by a trail of subsidiary numbers, which are in open competition with one another, and (to add to the confusion) appear at some stage to have undergone a process of 'disintegration' whereby integral quanta have been resolved into proper fractions

The difficulties arising from such causes as these are in large measure removed by the careful and concise exposition of Messrs Lessheim and Samuel, and it is a high compliment to their skill that we can claim to have been able to understand and to make use of the major portion of their monograph It was, indeed, only on reaching the tenth section of the book that it became necessary to add a marginal comment, "I cannot follow this," and to call in the help of a professional physicist to explain in fuller detail the complex behaviour of systems with several outer electrons The elaborate spectroscopic analysis of sections 12 and 13 was also too complicated to be understood at one reading, but it would be difficult to praise too highly the way in which the spectroscopic evidence is used in order to provide a sure foundation for definite chemical deductions, and it is one of the conspicuous merits of the book that this evidence is set out in such a convincing way, that its validity is no longer open to question even by the most extreme type of 'sceptical Chymist'

Much of the charm of the quantum theory of the present day arises from the introduction, by Goudsmit and Uhlenbeck in 1925, of the conception of the spinning electron This conception has, indeed, done more than anything else to bring order out of the chaos of subsidiary quantum numbers, and thus to restore to Bohr's theory some semblance of the simple and logical character which it possessed in 1913 From the chemical point of view, the principal merits of this early quantum theory was the provision of a logical basis for the valency theories of Kossel and Lewis, since it indicated the existence of groups of electrons with identical 'principal quantum numbers' $n = 1, 2, 3, 4, 5$, etc, corresponding with the K, L, M, N, O, etc, levels of the X ray spectra of the elements In this way it explained the inertness of the noble gases, and the ionisation of adjacent elements such as the halogens and the alkali metals, as depending on the exceptional stability of certain completed groups of electrons Since, however, the theory gave no clue to the number of electrons in each quantum group, these numbers must logically have followed the Rydberg series, with 2, 8, 8, 18, 18, and 32 electrons in successive levels, corresponding with the number of 'cells' which Langmuir postulated in successive layers or 'shells' of his static atomic model

[1] Die Valenzzahl und ihre Beziehungen zum Bau der Atome Von Hans Lessheim und Rudolf Samuel. (Fortschritte der Chemie, Physik und physikalische Chemie, herausgegeben von A Eucken, Band 19, Heft 3) Pp 98 (Berlin Gebrüder Borntraeger, 1927) 6 40 gold marks.

Two years later, in 1915, Sommerfeld found it necessary to introduce a second ('subsidiary' or 'azimuthal') quantum number k, in order to explain the fine structure of the hydrogen and helium spectra This 'subsidiary' quantum number immediately assumed a dominant position in spectroscopy, where series of spectroscopic terms for which $k=1, 2, 3, 4$, were distinguished by the capital letters S, P, D, F, corresponding with the initial letters of the 'sharp,' 'principal,' 'diffuse,' and 'fundamental' series of spectral lines with which the terms are associated It is unfortunate for the lay reader of spectroscopic literature that the fascinating explanation which Sommerfeld gave of the fine structure of hydrogen, as depending on the varying mass of electrons moving with varying velocity in elliptical orbits of different eccentricities, has now been abandoned in favour of a fine structure depending on a third (instead of on the second) quantum number, but the classification of Bohr's 'groups' of electrons into 'sub groups,' under the headings $n_k = 1_1 2_1 2_2 3_1 3_2 3_3$, etc, was nevertheless an advance of permanent value In particular, it was these sub groups which enabled Bohr in 1921 to develop his well known classification of the elements, in which the inertness of the noble gases is no longer attributed to the completion of the main groups with principal quantum number $n=1, 2, 3, 4$, etc, but to the completion only of successive n_1 and n_2 sub groups, as in the table below

X ray level	K	L	M	N	O	P
Quantum No	1_1	$\underbrace{2_1 2_2}$	$\underbrace{3_1 3_2} 3_3$	$\underbrace{4_1 4_2} 4_3 4_4$	$\underbrace{5_1 5_2} 5_3$	$\underbrace{6_1 6_2}$
He = 2 =	2					
Ne = 10 =	2	+ 8				
A = 18 =	2	+ 8	+ $\underbrace{8}$			
Kr = 36 =	2	+ 8	+ 18	+ $\underbrace{8}$		
X = 54 –	2	+ 8	+ 18	+ $\underbrace{18}$	+ $\underbrace{8}$	
Rn = 86 =	2	+ 8	+ 18	+ 32	+ 18	+ 8

This well known system of classification assigns an outer shell of 8 electrons to each of the noble gases, and explains the old 'law of octaves' by the repetition which results from building up this outer octet in one level after another It then proceeds to account for the properties of the transition elements of the first and second long periods as depending on a subsequent expansion of the M and N octets into shells of 18 electrons The final expansion of the N octet to a shell of 32 electrons (at a stage when the O and P levels are already partially filled) then provides a natural explanation of the still slower gradation of properties in the elements of the rare earth group

Since the number of similarly placed electrons was still undetermined, Bohr adopted the simple plan of distributing them equally amongst the sub-groups of a given level The N-level was therefore supposed to contain $4+4$ electrons in krypton, $6+6+6$ in xenon, and $8+8+8+8$ in radon It is, however, rather illogical to postulate that a condition of maximum stability exists in a sub group when occupied by 4 *or* 6 *or* 8 electrons Stoner therefore suggested in 1924 that the various sub groups should be filled up completely one after another, and then remain full to the end of the chapter It then follows logically that the sub groups for which $k=1, 2, 3, 4$, etc, must contain 2, 6, 10, 14, etc, or in general $2(2k-1)$ electrons, whatever may be the value of the principal quantum number n The close similarity between the members of the various natural families of elements was then explained by the identical development of successive sub groups differing only in their 'principal' quantum numbers Thus the alkalis all contain *one* electron in an n_1 sub group, whilst the alkaline earths contain a complete sub group of *two* electrons In the same way carbon and its homologues contain *two* electrons in an n_2 sub group, in addition to the two electrons in the n_1 sub group, whilst the inert gases contain a complete sub group of *six* n_2 electrons

In the periodic classifications of Bohr and of Stoner, the maximum number of sub groups in a group is fixed by the fact that k may have any integral value between 1 and n The number of sub groups is therefore equal to the principal quantum number n, and has the value 1, 2, 3, 4, 5, in the K, L, M, N, O levels Coster found, however, in 1921, that the X ray absorption spectra of the elements have a fine structure like that of hydrogen or helium, the number of components in the K, L, M, N, O, P levels being expressed by the series 1, 3, 5, 7, (5), (3), instead of the series 1, 2, 3, 4, 5, 6 In order to explain this result, he introduced a third quantum number in the form $n_{k_1k_2}$, where k is now written as k_1 and may be any integer between 1 and n as before, whilst k_2 may be either equal to k_1 or 1 unit less The sub groups of the preceding classification are thus divided up into 'grouplets' corresponding with a series of triple quantum numbers as follows 1_{11}, 2_{11}, 2_{21}, 2_{22} 3_{11}, 3_{21}, 3_{22}, 3_{32}, 3_{33}, etc This system gives the required series of 1, 3, 5, 7 components in the K, L, M, N levels, as required by the X ray spectra, and we may then suppose that, as in the optical spectra, the O and P levels are only partially filled

A third quantum number had already been introduced by Sommerfeld in 1920 in order to account for the composite character or 'multiplicity' of lines, such as the sodium doublet, which could not be explained by means of the first two quantum numbers Sommerfeld's 'inner' quantum number j can have integral values when there are *two* valency electrons which can move from orbit to orbit during the absorption or emission of light by the atom, as in the alkaline earths, but when there is only *one* of these electrons it becomes a half integer, and its value is given by the relation $j=k_2-\frac{1}{2}$ This third quantum number is evidently magnetic in origin, since it also explains the multiplicity which is developed when spectral lines are emitted in a strong magnetic field as observed by Zeeman in 1896 Under these conditions a single line is resolved into $2j+1$ components, where j is the inner quantum number

Thus if j is an integer, the lines break up into an odd number of components, but into an even number if j has a half-integral value

The significance of the third quantum number becomes clear only when a quantised spin is given to the electron The magnetic moment s of the spinning electron can then be either positive or negative, but, since there is no intermediate resting state, only a single quantum separates the two states For the sake of symmetry, therefore, these states are written $s = \pm\frac{1}{2}$ for each electron, and we have at once a plausible explanation of those half quantum numbers which have so often caused the sceptical to scoff The total magnetic moment j of a planetary electron is then made up of two parts, the magnetic moment of the orbit l and of the spin s, so that $j = l \pm s$, since the moments may either work together or oppose one another The magnetic moment l of the orbit is a function of the second or 'subsidiary' quantum number k, and is given by the simple relation $l = k - 1$ Thus if $k = 1$ (as in the S terms of a spectroscopic series) $l = 0$, and since $j = l + s$ cannot be negative, the only possible value of the 'inner' quantum number when $s = \pm\frac{1}{2}$ is $j = \frac{1}{2}$ If, however, $k = 2$ (as in the P terms of a spectroscopic series), then $l = 1$, and $j = l + s$ can have the *two* valves $j = \frac{1}{2}$ or $j = \frac{3}{2}$ An electron fall from a 2_2 to a 1_1 orbit can thus give rise to the yellow doublet of sodium, since the falling electron may be spinning either in the same sense as its revolution in the orbit or in the opposite sense

The introduction of the second quantum number had the effect of breaking up the main groups of 2, 8, 18, 32 electrons into sub groups of 2, 2 + 6, 2 + 6 + 10, and 2 + 6 + 10 + 14 electrons The third quantum number has the effect of breaking up these sub groups into tiny grouplets containing small even numbers of electrons Thus Bohr's big group of 32 N electrons is resolved into the following grouplets

$$\begin{array}{ccccccc} 4_{11} & 4_{21} & 4_{22} & 4_{32} & 4_{33} & 4_{43} & 4_{44} \\ 2 & 2 & 4 & 4 & 6 & 6 & 8, \end{array}$$

and the 54 electrons of xenon are now distributed amongst 17 grouplets as follows 2, 2 + 2 + 4, 2 + 2 + 4 + 4 + 6, 2 + 2 + 4 + 4 + 6, 2 + 2 + 4 This has the effect of emphasising more strongly than ever the significance of the duplet or pair of electrons, since each completed grouplet is magnetically inert, but the octet is relegated to a subsidiary position as a mere summation of the first three grouplets in a group which contains $2n - 1$ of these tiny clusters

In order to complete this process of resolution, we must now proceed to consider the fourth quantum number m, which represents the various settings of the atom in an external magnetic field This fourth quantum number changes by one unit at a time from $+j$ to $-j$, and may therefore be either integral or half integral The number of settings for a given value of j is given by the formula $2j + 1$, thus if $j = \frac{1}{2}$, $m = \pm\frac{1}{2}$ and has *two* values, if $j = 1$, $m = -1, 0, +1$ and has *three* values, whilst if $j = \frac{3}{2}$, $m = -\frac{3}{2}, -\frac{1}{2}, +\frac{1}{2}, +\frac{3}{2}$ and has *four* values The total number of settings of the *four* quantum numbers n, l, j, and m is then found to agree exactly with the maximum number of electrons that can be collected in groups, sub groups, and grouplets round the nucleus We are therefore at last in a position to appreciate Pauli's 'exclusion rule,' according to which no two electrons in an atom can have the same four quantum numbers, n, l, j, and m A sample of the table which expresses this rule is reproduced below

				Number of Settings.			
$n = 1, 2, 3, 4, 5, 6$	$l = 0$	$j = \frac{1}{2}$	$m = -\frac{1}{2} + \frac{1}{2}$	2	2	8	
$n = 2, 3, 4, 5, 6$	$l = 1$	$j = \frac{1}{2}$	$m = -\frac{1}{2} + \frac{1}{2}$	2	6		
		$j = \frac{3}{2}$	$m = -\frac{3}{2} + \frac{1}{2} + \frac{1}{2} + \frac{3}{2}$	4			18
$n = 3, 4, 5, 6$	$l = 2$	$j = \frac{3}{2}$	$m = -\frac{3}{2} - \frac{1}{2} + \frac{1}{2} + \frac{3}{2}$	4	10		
		$j = \frac{5}{2}$	$m = -\frac{5}{2} - \frac{3}{2} - \frac{1}{2} + \frac{1}{2} + \frac{3}{2} + \frac{5}{2}$	6			32
$n = 4, 5, 6$	$l = 3$	$j = \frac{5}{2}$	$m = -\frac{5}{2} - \frac{3}{2} - \frac{1}{2} + \frac{1}{2} + \frac{3}{2} + \frac{5}{2}$	6	14		
		$j = \frac{7}{2}$	$m = -\frac{7}{2} - \frac{5}{2} - \frac{3}{2} - \frac{1}{2} + \frac{1}{2} + \frac{3}{2} + \frac{5}{2} + \frac{7}{2}$	8			

This table gives a picture of the periodic classification from which all individuality is excluded, since exactly the same sequence recurs when $n = 2, 3, 4$, etc It thus represents one of the main characteristics of the elements perfectly, namely, the recurrence of types such as the halogens, noble gases, and alkalis at appropriate intervals, but in practice the elements of a given family are far from uniform in their behaviour, so that even the formal valencies vary erratically in a family such as copper, silver, gold It is therefore satisfactory to find that the spectroscopic evidence, when examined in detail, gives similar indications of more complex developments Thus it is found experimentally that, in the elements of the *first* transition series, the grouplet 4_{11} of the N level is occupied by *two* electrons (except in chromium and copper) so that all these elements readily form bivalent ions In the same way, the first two elements (yttrium, zirconium) of the *second* transition series have *two* electrons in the 5_{11} grouplet of the O level, but at this stage there is an abrupt change, since the following elements (niobium, *et seq*) have only *one* electron in the 5_{11} grouplet, and palladium actually has *none* In the next group of transition elements tungsten appears to have *two* electrons in the 6_{11} grouplet, but no conclusion can be drawn in reference to the other elements of this transition series, since the relevant spectroscopic data are not yet available These unforeseen 'anomalies' are of peculiar interest, since they show that the individuality of the elements, which makes inorganic chemistry appear so much less systematic than organic chemistry, is manifested also in their spectroscopic behaviour, which may therefore be expected to provide a clue to the common origin of these physical and chemical anomalies in the electronic configuration of the atom

A particularly interesting comparison can be made between nickel, palladium, and platinum The structure of these three elements could be represented most easily by assigning an outer

shell of 18 electrons to each metal, as in the scheme

$$
\begin{array}{l}
\quad\quad\ K \quad L \quad M \quad N \quad O \\
\mathrm{Ni} = 2 + 8 + 18 \qquad\qquad = 28 \\
\mathrm{Pd} = 2 + 8 + 18 + 18 \qquad = 46 \\
\mathrm{Pt} = 2 + 8 + 18 + 32 + 18 = 78
\end{array}
$$

This structure is correct in the case of palladium, which appears to contain a series of complete grouplets, since it is only feebly paramagnetic and gives a spectrum with some of the characteristics of a noble gas, but it is no longer true for nickel and platinum, the spectra of which are more like those of the alkaline earths, so that their structure may be represented more efficiently by the schemes $2+8+16+2$ and $2+8+18+32+16+2$

The spectroscopic data thus explain the typical bivalency of nickel and its resemblance to the bivalent transition elements with which it is associated, but they do not throw much light on the chemistry of palladium and platinum, since these two metals do not show any analogous contrast in their chemical behaviour If, however, we consider the coinage metals of the succeeding family, Cu = 29, Ag = 47, Au = 79, the value of the spectroscopic data is at once seen Thus, since palladium contains only completed groups or sub groups of electrons, and has therefore a very stable electronic configuration, it is natural that silver should exhibit the simple spectrum and rigid univalency of an alkali metal, as expressed in the scheme $\mathrm{Ag} = 2+8+18+18+1$ In the case of copper, the univalency of the element in its cuprous salts is similarly expressed in the scheme $\mathrm{Cu} = 2+8+18+1$ In strict conformity with this scheme, the cuprous ion, $\mathrm{Cu}^{+} = 2+8+18$, which has three levels completely filled, is diamagnetic, but the cupric ion, which possesses an incomplete shell $\mathrm{Cu}^{++} = 2+8+17$ is paramagnetic Since copper is usually bivalent, we might expect to find spectroscopic evidence of a configuration $\mathrm{Cu} = 2+8+17+2$, corresponding with $\mathrm{Ni} = 2+8+16+2$, with two electrons in the 4_{11} grouplet, but this does not appear to have been observed On the contrary, the presence of quadruplet groups in the spectrum of copper indicates the presence of *three* unpaired electrons round the central nucleus This brings the metal into line with nickel, but in a different way, since the stable core of electrons has $2+8+16$ electrons in each case, but it is not in accord with the chemical properties of the element, which may be univalent but is never tervalent

The univalency of gold finds expression in the configurations

$$\mathrm{Au} = 2+8+18+32+18+1,$$
$$\mathrm{Au}^{+} = 2+8+18+32+18,$$

which show the presence of *one* easily detached electron in the *P* level Its tervalency can be deduced from the analogy between the spectra of platinum and those of the alkaline earths with *two* easily detached electrons, since this indicates the existence of a stable core with 16 *O* electrons as in the scheme

$$\mathrm{Au}^{+++} = 2+8+18+32+16,$$
$$\text{compare } \mathrm{Pt} = 2+8+18+32+16+2$$

In this connexion, the univalency of thallium, which finds expression in the scheme $\mathrm{Tl}^{+} = 2+8+18+32+18+2$, is of interest, since it provides further evidence of the stability of the outer sub group of two 6_1 electrons which has already been deduced from the spectroscopic data for platinum

The introduction of sub groups of elements has the interesting effect of removing carbon and silicon from the central position which they have long occupied in the minds of chemists as the middle

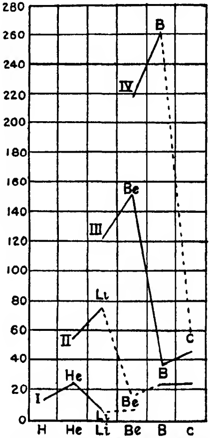

FIG 1 —Diagram showing the ionisation potentials required to remove 1 2 3, or 4 electrons from the first six elements.

members of the two short periods of elements From the spectroscopist's point of view, however, a sub group 2_1 or 3_1 has been completed at beryllium and magnesium, and it only remains to build up the six electrons of the 2_2 or 3_2 sub groups in order to give the configuration of a noble gas In this process, nitrogen and phosphorus usurp the median positions, and this is revealed by an unexpected symmetry in the spectroscopic terms of the elements on either side Thus the spectrum of magnesium shows some resemblance to that of argon, whilst aluminium and chlorine, and silicon and sulphur form similar pairs, in which the electrons which are present in one element are represented by gaps in the other A similar symmetry is seen on either side of manganese in the transition elements of the first long period,

where the 3_3 sub group is being filled up, but in this case the symmetry is marred by the fact that chromium and copper have only *one* outer electron instead of two in the 4_{11} grouplet In the elements of the rare earths, where the 4_4 sub-group is being filled with fourteen electrons, gadolinium occupies a central position in a series of fifteen elements ranging from lanthanum to cassiopeium, but in this case the central element is characterised by an extraordinary maximum of multiplicity, $r = 17$, which is far in excess of the previous maximum values, namely, $r = 4$ for nitrogen and phosphorus, and $r = 6$ for manganese, or $r = 7$ for the anomalous spectrum of chromium

The culminating feature of Messrs Lessheim and Samuel's monograph, in our experience, is found in a diagram of ionisation potentials (Fig 1), which provides the most convincing proof of the real existence of electron groups The minima at Li^+, Be^{++}, B^{+++}, and C^{++++} show how easy it is to remove the whole of the electrons from the L level in lithium, beryllium, boron, and carbon, but, on attempting to remove one more electron, an immense resistance is at once encountered to the disintegration of the still complete K shell, and the ionisation potential leaps up to a maximum When once this shell is broken, however, only a feeble resistance is offered to its complete removal Thus the two L electrons can be removed from an atom of beryllium by two increments of about 8 and 7 volts, but the removal of the two K electrons requires the successive addition of 138 and 46 volts to the previous total of about 15 volts The most striking feature of these numbers is the drop of nearly 100 volts in the extra work that is required to strip the nucleus bare by the removal of one more electron when once the K shell has been broken Even the tiny duplet of the 2_{11} grouplet appears, however, to put up an appreciable resistance to disruption, since rather less extra work is required to remove an electron from the ion Be^+ than from the neutral atom Be Facts such as these provide ideal evidence in support of the main thesis of the electronic theory of valency, that chemical affinity in all its various manifestations depends on the superior stability of certain numerical groups of electrons when under the influence of a positively charged nucleus In our opinion, this thesis now rests on an impregnable rock of experimental proof T M Lowry

Christian Huygens, 1629–95

Of all men of science whose lives were passed within the compass of the seventeenth century, none has a more lasting reputation than the Dutch mathematician, natural philosopher, and inventor, Christian Huygens Born on April 14, 1629, three hundred years ago, at a time when the work of Kepler, Galileo, Napier, Gilbert, and Harvey was slowly gaining acceptance, he lived to read Newton's "Principia," and during the course of his career saw the rise of experimental science, the erection of famous observatories, and the foundation of our greatest scientific societies, the Royal Society and the Paris Academy of Sciences, of the latter of which he was the first foreign associate

Huygens' birth, and his death on June 8, 1695, both took place at the Hague, and his tomb, like that of his illustrious countryman, Boerhaave, is there in St Peter's Church With advantages of birth, education, wealth, and position, Huygens possessed a studious and industrious mind, and an even and cheerful temper, and by the exercise of his brilliant intellect he raised himself to pre eminence among his contemporaries Trained in the law and for a short time attached to a Dutch embassy, he was all his life free to follow his own bent, and his long sojourn in Paris, where he enjoyed the seclusion of the Bibliothèque Roi, and his visits to England, no less than his investigations, discoveries, and inventions, led to his being esteemed by a wide circle of friends

The life and works of Huygens have been published and republished, but reference can be made to only one or two of his great contributions to the advancement of knowledge Attracted in his youth, like many of his fellows, to the construction and improvement of telescopes, on Mar 25, 1655, Huygens discovered Titan, the sixth, but the first seen, of the satellites of Saturn, and then gave the true explanation of the curious appearance of the 'triple planet' This discovery of Saturn's ring he made known in the form of a logogriph, which is reproduced by Grant in his "History of Physical Astronomy" In after years Huygens presented to the Royal Society an object glass of 122 feet focal length for an 'aerial telescope,' for the mounting of which Halley was commissioned by the Society to "view the scaffolding of St Paul's Church" to see if it could be used for erecting the object glass

From astronomy and telescopes Huygens turned to clocks, and on June 16, 1657, presented the first pendulum clock to the States General Described later in his famous work 'Horologium Oscillatorium," of 1673, a replica of the clock is to be seen in the Science Museum Of that famous work, it has been said that it contained original discoveries sufficient to have furnished material for half a dozen striking disquisitions, while 'the theorems on the composition of forces in circular motion with which it concluded formed the true prelude to Newton's 'Principia' and would alone suffice to establish the claim of Huygens to the highest rank among mechnaical inventors" This work, like his "Traité de la Lumière," in which he enunciated the undulatory theory of light, was written while he lived in Paris

Returning to his native country in 1681, Huygens continued his writings, and his last work, "Cosmotheoros," was in the printers' hands when he was attacked by the illness which proved fatal It is said that Flamstead recommended the "Cosmotheoros" to Dr Plume, archdeacon of Rochester, who was so struck with it that he left £1800 to found the well known Plumian professorship of astronomy at Cambridge

Obituary.

Dr Alex Hill

DR ALEX HILL, whose death was recently recorded in Nature, was born at Loughton, Essex, and educated at University College School and at Downing College, Cambridge; in 1880 he was elected a fellow of the College, from 1888 to 1907 he was Master of Downing, and from 1897 to 1899 Vice Chancellor of the University. He studied medicine and surgery at St Bartholomew's Hospital; in 1884–85 he was Hunterian professor of the Royal College of Surgeons.

The greater part of Dr Hill's life was spent in the advancement of learning; his services, not being confined to the routine of academic life, were given widely to educational causes. He assisted in the formation of the National Home Reading Union, of which he was the chairman from 1888 to 1908. He served as president of the Teachers' Guild of Great Britain, and was a member of various educational committees, including the Welsh Colleges Committee, 1907–8, and the Advisory Committee of the Treasury on Universities, 1901–6.

A versatile and an attractive writer, Dr Hill was the author of several books and papers on physiology and on other subjects connected with the profession for which he had been trained. His geniality, personal charm, and eloquence attracted crowded audiences in various parts of the country, when as a Gilchrist Lecturer he dealt with physiological and psychological subjects such as "Man under the Microscope" and "Dual Personality". His literary gifts were evident in his series of lectures on Browning and in his interpretation of the poet in his "Notes on Browning".

Dr Hill was zealous in his advocacy of university education, and having formed the conception of university institutions as centres of educational influence in areas not already served by universities, he strove to put his ideals into practice. With this aim in view he accepted an urgent appeal to become the Principal of University College, Southampton, a position which he took up in January 1913. His task was not an easy one, but he entered on it with characteristic enthusiasm; his winsome personality had an immediate effect on all branches of the College activities, and he was able to secure support for the new College buildings which had been planned for the present site at Highfield. The outbreak of the War so soon after he had entered upon his duties was a serious blow to the growing College; a large number of the staff and students joined the forces, and the new buildings were occupied as a war hospital. Dr Hill's own residence at Highfield Hall, which he had taken as a centre for the social activities of the College, he gave up to the Red Cross Society, and lived in a house near it in order to be able to assist the work of the hospital. Always a hard worker, his energy during the War was boundless, for in addition to carrying on his duties as Principal of the College, he took on himself the work of the Universities Bureau when his assistant secretary joined the forces. His recreation was in the garden attached to Highfield Hall, and even at this strenuous period of his life he rose early each morning to work in the garden, where he grew vegetables and flowers for the wounded soldiers in the hospital.

The work with which Dr Hill especially identified himself since 1912 was that of secretary of the Universities Bureau of the British Empire. The Bureau owes its inception to Dr Hill, who, when he resigned his position as Principal of the University College, Southampton, told the writer that there were two claims both very dear to him, those of the College and the Bureau; but whilst he felt that others could carry on the work of the College, the Bureau was his own child, and his one aim in life was to nurse it and to bring it to maturity.

A man of broad sympathies and wide vision, Dr Hill endeared himself to those who knew him. His tour with his family, so well described in his book "Round the British Empire," strengthened his vision and he felt more intensely that the work which he was undertaking was a means of cementing more firmly the bonds of Empire. Since 1920, although his work was mainly in London, his home was in Southampton, and his connexion with the College maintained by his election as a vice president. He died at 'Granta,' Upper Bassett, Southampton, on Feb. 27, and leaves a widow, a son, and a daughter.

J. Eustice.

We regret to announce the following deaths:

M. J. Boussinesq, member of the Section of Mechanics of the Paris Academy of Sciences and author of a mathematical work on the theory of light, on Feb. 19, aged eighty six years.

Sir Anthony Bowlby, Bart., K.C.B., K.C.M.G., K.C.V.O., a past president of the Royal College of Surgeons of England, on April 7, aged seventy three years.

Dr Jonathan Dwight, president in 1923–26 of the American Ornithological Union, on Feb. 22, aged seventy years.

Dr H. B. Gray, formerly warden of Bradfield College, and president in 1909 of Section L (Educational Science) of the British Association, on April 5, aged seventy seven years.

Sir George Knibbs, C.M.G., Commonwealth statistician from 1906 until 1921, and president in 1923–24 of the Australasian Association for the Advancement of Science, aged seventy years.

Dr Thomas B. Osborne, since 1886 research chemist in the Connecticut Experiment Station, who was an honorary fellow of the Chemical Society of London, and was distinguished for his work on the chemistry of the vegetable proteins and related subjects, on Jan. 29, aged sixty nine years.

Sir Henry Rew, K.C.B., sometime Assistant Secretary, Ministry of Agriculture, and a past president of the Royal Statistical Society and of Section M (Agriculture) of the British Association, on April 7, aged seventy years.

Dr Thomas Scott, associated for many years with the Scottish Fishery Board Laboratory and known for his work on the smaller marine crustacea, especially copepoda, in recognition of which the University of St Andrews conferred on him the honorary degree of LL.D., on Feb. 25, aged eighty eight years.

News and Views.

THERE are two thinkers in England just now working on very similar lines, investigating the relations of science and art Both are 'emeritus' professors, Lloyd Morgan of Bristol, Alexander of Manchester, and every reader of any of their publications on the subject must be struck by the earnestness and penetration of their work and the palpable and complete sincerity of their minds It is much to be hoped that they will persevere and that Prof Alexander, who has already several lectures and pamphlets on the subject to his credit, will soon be able to bring out the systematic volume which he has in mind Prof Lloyd Morgan gave two lectures at Bristol last November entitled "Science and Drama" (University of Bristol), which really deal with the same topic He uses the term 'drama' in the widest possible sense in order to cover all forms of 'agency,' and while in the first he considers the question of 'agency' in respect of natural phenomena which are studied in science, in the second he examines in detail what Alexander has already said about the action of the mind in art, on the whole accepting it and adding certain glosses' of his own

PROF LLOYD MORGAN'S second lecture sums up and gives the author's own point of view in his now familiar phrase of 'emergence' Science and art, he tells us, both give entry to a realm which is transformed in contrast with the world of naive perception The square box, for example, which we see as we move about in a room is transformed by the most elementary operation of science into a cube We never see it as a cube but we think so consistently in a transformed mental attitude that we always say that what we see is really a cube The difference in this respect between the man of science and the artist is that for the latter it is always the appearance which in his sense is the real There is, however, in both cases the scientific and the artistic result, something added by the thinker or the artist In the latter case the artist transforms the real as he perceives it into something having an 'art value,' and it is in this process of transformation, whether of the artist himself or of those who follow him in appreciating his work, that Prof Lloyd Morgan finds the new or 'emergent' attitude of mind which is the keystone of his philosophy It is the turning point in mental development, and probably not attained by the animal or the little child Then comes a careful and stimulating analysis of Alexander's account of the same process The two philosophers by no means agree on all the points which arise, and it is this comparison of results which makes the discussion so interesting English writers have not hitherto equalled the best of the German, Italian, or French philosophers who have studied æsthetic, and it is therefore the more gratifying to find a pair of subtle and mature minds engaged in friendly competition to fathom the depths of one of the most fundamental problems of thought Both, it should be noted, agree in placing the decisive element in the thinking mind

IN a recent leading article in NATURE (Feb 16, p 233) the connexion between forests and agriculture as considered in the Report of the Royal Commission on Agriculture in India was considered In different parts of India, a study of the history of the past sixty years or so has resulted in the steady growth of an opinion which recognises that there is a definite relation between unchecked abuses in the forest (by axe, fire, and overgrazing) and subsequent forest degradation, erosion, drying up of the waters and covering up of valuable agricultural lands Those who have studied these problems in India will not, perhaps, be aware how widespread and important they have become in other parts of the world Recently (Feb 27–Mar 1) a three days' joint session of the American Forestry Association and the Florida Forestry Association was held at Jacksonville Fla, to discuss the position of the southern forests and their industrial, conservational and recreational significance to the United States The main object of the meeting, according to a *Daily Service News Bulletin* issued by Science Service, Washington, D C, was a consideration of the steps to be taken "to reclaim for full production the vast tracts of southern land that are better adapted for forest crops than for any other purpose" One of the sessions was devoted to a consideration of the fire evil "Forest fires in the south," it is said, "are different from those in other parts of the country in that most of them are deliberately started by cattle owners under the mistaken impression that burning improves pasture How to persuade these people that they are burning money out of their own pockets is one of the most pressing problems confronting southern forestry men" Forestry men in India have been engaged upon this problem for sixty years and more, and Florida foresters could doubtless study the work of the past in India with profit

MR E A SHERMAN, of the United States Forest Service, in dealing with the important problem of soil exhaustion and erosion as a result of the destruction of the forests, said "Our fields have been robbed of their fertility almost beyond human comprehension Millions of acres have, through our ignorance, been rendered relatively worthless The far sighted thrift upon which was founded that part of the common law which places a taboo upon waste is still sufficiently inherent in our people to assure us that it will be applied as soon as the man in the street realises the presence of that waste and its extent He will insist upon prohibiting forms of agriculture that result in a permanent shrinkage in our total agricultural domain Economic pressure and the pressure of public opinion will combine to exclude certain classes of land from cultivation until such time as such use justified the investment necessary to adapt them for permanent tillage Meanwhile such lands may serve a useful and very valuable purpose as forests Forestry use not only safeguards the fertility of the soil from destruction, but actually contributes to its upbuilding" Mr Sherman in the above words

might have been speaking for many parts of the British Empire where problems of the kind, through mismanagement or ignorance in the past, are urgently demanding a solution

AT the quarterly meeting of the Grand Council of the British Empire Cancer Campaign held on Monday, April 8, the summary of the recommendations made by the Committee of the International Cancer Conference held last July was passed to the Investigation Committee of the Campaign to take action in initiating executive action on the proposals In the matter of radium and X rays, the Committee stresses the necessity for the institution of standardised records of results of patients treated by radium and X rays, and urges that the Campaign, in collaboration with the Medical Research Council and the Ministry of Health, should invite all institutions using radium and X rays to utilise an agreed form of record The Grand Council received the final reports on the subject of the Garton Prize, which has been instituted by the British Empire Cancer Campaign for the purposes of promoting investigations into the nature, causes, prevention, and treatment of cancer It was announced that a medal, with an honorarium of £500, will be awarded to the person, or group of persons, who shall submit the essay embodying the results of original investigations which, in the opinion of the judges appointed by the Grand Council, is the best contribution towards "The Early Diagnosis of Cancer"

THE recent presentation by Messrs Thos W Ward, of Sheffield, to the North Eastern Railway Museum at York, of some old rack rails and wheels from the Wylam wagon way has attracted considerable attention in the Press, and the Wylam wagon way has been referred to as the earliest railroad in the world On such matters there is often confusion of thought, and it should be remembered that railroads existed a very long time before locomotives were introduced Longitudinal wooden timbers were adopted on roads in mining districts in the fifteenth century and their use in the north of England was a factor in the development of our coal industry By the beginning of the nineteenth century they were in general use, but all haulage was by horses Cast iron plates or edge rails were introduced towards the end of the eighteenth century All such railroads were, however, private concerns, and the first public railroad was the Surrey Iron Railway, which was completed to Croydon in 1803 and to Merstham in 1805, but was never carried as far as Portsmouth, which was its intended destination The Wylam line is of course bound up with the introduction of the steam railway about ten years later

IN a paper read to the Newcomen Society on Mar 27, Mr W A Benton dealt with the subject of weighing heavy loads, and especially with the invention of the compound lever machines by John Wyatt of Birmingham Peoples of oriental or classical antiquity possessed no other weighing machines except those of the equal armed balance and the steelyard, and the maximum capacity of such machines during the Middle Ages does not appear to have exceeded one or two tons One such high capacity wooden beam has survived at Neisse, in Prussia The claims sometimes made that the compound lever weighing machine was first used by the Italian physician, Santori Santoria (1561–1636) do not appear to be substantiated, though he introduced the practice of weighing his patients During the eighteenth century huge steelyards were introduced for weighing loaded carts, two specimens of which still exist in England, one at Soham, Cambridgeshire, and the other at Woodbridge, Suffolk Wyatt's invention was made about 1744, and the machines with compound levers are described in encyclopædias at the end of the century An examination of the Wyatt manuscripts, however Mr Benton said, failed to throw much light on the early history of Wyatt's invention, which forms the basis of all platform weighing machines to day A carpenter by trade, Wyatt was born near Lichfield in 1700 and died on Nov 29, 1766, his tomb being in the churchyard of St Philip's, Birmingham Mr Benton was able to illustrate his paper with lantern slides and models, some of the latter coming from the historical museum of Messrs W and T Avery, Ltd, Birmingham, whose works occupy the site of Boulton and Watt's famous Soho Foundry

AMERICAN museums continue to make great advances in their efforts to reach and teach the people In connexion with the Brooklyn Children's Museum, a new building—larger and finer than many of the local museums of Britain has just been opened to the public, and the increase of space has suggested many improvements in the storing and lending of material The library section, in addition to its books which are open to inspection by the children, possesses 8000 lantern slides catalogued on the Dewey system, a file of 5000 pictures so indexed that any teacher or child may borrow a set of them for special school work, and a collection of excerpts from the *National Geographic Magazine*, arranged according to subject and also available for borrowing It is still more interesting to learn that from the hall in which the Hooper Memorial Loan Collections are displayed children may borrow and take home small cases containing mounted birds, which they take off the shelves just as they might borrow a book A new type of history room is to be created at the Brooklyn Children's Museum as the result of a gift of 15,000 dollars by Mrs John Mills The room will contain a unique collection of twenty five historical scenes in miniature, illustrating significant events in the progress of the human race They will begin with the cave men and will show that ideas, rather than wars and weapons, have been responsible for the progress of mankind Further groups will tell of the discovery of painting, the development of the drama, the science of navigation, the application of steam and electricity, and the conquest of the air Mr Dwight Franklin, of New York, who is already well known for this class of work, will prepare the historical groups, and it is expected that the creation of the twenty five groups will occupy about two years

IN paper mills and rubber factories trouble often arises from large sparks due to the statical electricity

generated by the running machinery Various remedies have been suggested for reducing the fire risk due to this effect In a recent *Daily Science News Bulletin*, issued by Science Service of Washington, D C, a somewhat novel method used by a large Russian rubber factory is described for avoiding the danger of fire In the factory, when the rubber solution flows over the fabric base and dries on it, large charges of static electricity are produced by the friction of the rubber covered fabric with parts of the drying machinery When the stress at the surface gets greater than the electric strength of air, a hot 'fat' spark is produced similar to the ignition spark of a magneto, and this may start a fire, or cause an explosion as the air in the drying room is always saturated with highly explosive vapours A usual method in Great Britain is to use a fine wire brush to collect the charges and let them pass to earth, but sparks cannot be altogether prevented in this way In the Russian State factory in Leningrad a capsule of radium is placed near the point where the electricity is generated The radiations from the radium ionise the air, and so the electric charges flow through it harmlessly to the earth The cost of the installation is very low, as one milligram of radium is quite sufficient to prevent sparks from taking place, and it will doubtless last for many years The method has been known for a long time, but this industrial application is a useful one

THE first Young Farmers' Club in Great Britain was formed by United Dairies, Ltd, at Hemyock in Devon in 1921, and from the start the movement has been remarkably successful Whereas in 1924 there were only about 30 clubs and 600 members, now there are 100 clubs with a membership of about 2000 A fresh indication of enterprise is the recent issue of a monthly illustrated journal entitled *The Young Farmer* (National Association of the Young Farmers' Clubs, 26 Bedford Square, London, W C 1, price 3*s* a year) Much interesting information is given in the first issue by various authors concerning the aims, growth, and activities of the movement From the outset it was realised that though it was ideal for the organisation to be independent and self supporting, yet some outside help would be necessary for a start In 1924 the Ministry of Agriculture accepted a measure of responsibility, and now the support of the National Council of Social Science has been secured, and a National Association of Young Farmers' Clubs has been formed under its auspices Such centralisation, together with the help of the new journal, should do much towards creating corporate feeling between the individual clubs Titles of articles in the first issue, such as "My Experiences at the Dairy Show in 1928," "Coaching an International Cow Judging Team," "Boys and Girls in Rural Ontario," "A Year's Work in a Bee Club," serve to indicate the varied nature of the contents

THE considerable extension of fur farming in Great Britain during the last few years suggests that the attention of inquirers should be directed to a leaflet just issued by the United States Department of Agriculture, "Recommendations to Beginners in Fur farming" In gives in summary form, with references to further literature, general information on how to make a start areas suitable for farming, species suitable for propagation, where to obtain breeding stock The instruction is scanty, but it may be readily supplemented by consultation of the special publications of the Department, which are mentioned

THE Czechoslovak National Research Council, which is incorporated in the International Research Council, concluded its fifth year's activity at a general meeting held in Prague on Mar 16 The president, Prof Syllaba, opened the meeting by defining the functions of the International Research Council and the Czechoslovak National Research Council, which latter is an offspring of the Czech Academy of Sciences In conclusion, Prof B Němec delivered an interesting lecture on "International Aspects of Czech Science," in which he pointed out the twofold duties of scientific workers of a small nation, namely, to cultivate their national science and to present their achievements before the international world The annual report which has recently been published, describes the activities of the ten sections of natural sciences, medicine, and engineering, and gives the names of the 82 members

BY an Act of Congress the United States of America have established a Gorgas Memorial Institute of Tropical and Preventive Medicine in Panama, and the memorial laboratory has just been opened Surgeon General William C Gorgas, who died in 1920, went to the isthmus of Panama to report on the sanitary conditions of the Canal Zone in 1904, he was appointed chief health officer for the region, which was then notorious for malaria and yellow fever His work there, a monument to scientific and administrative hygiene, made the Canal Zone an inhabitable and even healthy area The first director of the new laboratory is Dr Herbert C Clark, who was with General Gorgas in the Canal Zone for several years Congress has authorised a permanent appropriation of 50,000 dollars a year for maintenance, and Latin American governments have been invited to contribute up to 75 per cent of the amount given by the United States

THE Bureau for Contraceptive Advice, Baltimore, Maryland, has issued its first statistical report, compiled by Prof Raymond Pearl The number of women (all married), attending was 168, their average age was just under 31 years, and the average duration of marriage 12 3 years One half of the women who attended the Bureau had been pregnant more than six times and had borne five or more children before they came Such reproductive rates are not conducive to either private or public health, and the figures given demonstrate the value of such a clinic as a health measure and lend no support to some of the objections that have been advanced against contraceptive measures

A LEADING article in the latest number of the *Scottish Naturalist* entitled "More Opportunities for

Naturalists Natural History as a Profession," points out the need for the creation of trained biologists to fill the increasing number of posts available in Great Britain and its colonies "There never has been a time when so many opportunities offered themselves for young men who desire to follow natural history as a career, nor a time when so few men could be found to fill the posts that await them" It is shown that the posts in question cover a wide variety of work, giving scope for outdoor observation and opportunities for biological research, and an indication is given of the scales of salary which may be expected here and abroad

The Report on the Health of the Army ' for the year 1927 has recently been issued (London H M S O) The incidence of sickness among soldiers during the year was somewhat higher than that of the preceding year, being 467 7 per 1000 of the strength, accounted for by the high incidence of infection during the early months of the defensive occupation of Shanghai The principal causes of admission to hospital were malaria, 9265 cases, venereal diseases, 9186 cases, and inflammation of tonsils, 6322 cases The high incidence of tonsillitis still remains unexplained As in the previous year, inflammation of the middle ear heads the list as cause of invaliding Diphtheria was comparatively prevalent with 317 admissions, while the enteric groups of fevers numbered only 239 cases for the whole army, including India, a remarkable record

Prof Pieter Zeeman, of the University of Amsterdam, has been elected an honorary fellow of the Physical Society of London

The George Darwin Lecture of the Royal Astronomical Society will be delivered at the meeting of the Society on May 10, by Prof E Hertzsprung, who will take as his subject The Pleiades

Prof F O Bower emeritus professor of botany in the University of Glasgow, will give the Huxley Memorial Lecture at the Imperial College of Science and Technology, London, S W 7, on May 3 at 5 30 P M His subject will be 'The Origin of a Land Flora reviewed Twenty one Years after Publication

The fourteenth Guthrie Lecture will be given before the Physical Society by Prof P W Bridgman, Hollis professor of mathematics and natural philosophy in Harvard University, on the properties of the elements under high pressures, at 5 o clock on April 19, in the Imperial College of Science, Imperial Institute Road, South Kensington Admission is free without ticket

It was announced by the president of the Linnean Society of London, at the meeting held on April 4, that the Linnean Medal, which 'is awarded each year to an eminent biologist as an expression of the Society s estimate of his services to science," is to be given to Prof Hugo de Vries, the veteran emeritus professor of botany in the University of Amsterdam, who is best known for his mutation theory of the origin of species

The gold medal of the Institution of Mining and Metallurgy has been awarded conjointly to the Hon William Lawrence Baillieu and William Sydney Robinson "in recognition of their services in the development of the mineral resources of the Empire, with special reference to the zinc and lead industries of Australia" The medal (in duplicate) will be presented at the annual general meeting of the Institution to be held at Burlington House on Thursday, May 16

The following office bearers were elected at the meeting of the Royal Philosophical Society of Glasgow on Mar 27 —*Vice President* Mr Robert A Burr, *Members of Council* Prof E P Cathcart, Dr James W French, Mr Thomas Henderson, Mr Andrew A Mitchell, *Hon Treasurer* Sir John Mann, *Hon Librarian* Dr James Knight, *Hon Secretary* Dr Charles R Gibson, *Hon Auditors* Mr Alex Murdoch, Mr John T Tulloch, *Acting Secretary* Dr James M Macaulay

A special feature of the first annual conference of the International Society of Experimental Phonetics, to be held at Hamburg on July 24–31, will be the provision for practical demonstrations and exercises in the study of speech by the graphic method Each participant will have an opportunity of becoming familiar with this method of investigating language, dialects, speech defects, the speech of the deaf, and nervous diseases This method is that of the Abbé Rousselot with the later improvements Information concerning the conference can be obtained from Prof E W Scripture, Strudelhofgasse 4, Vienna

At the annual general meeting of the Ray Society held on Mar 21, the following officers were re elected *President* Prof W C M Intosh, *Treasurer* Sir Sidney F Harmer *Secretary* Dr W T Calman Dr R W T Gunther was elected a vice president, and Mr R Adkin and Mr R Gurney were elected new members of council In the report of the council it was announced that the third and final volume of the ' British Hydracarina, ' by Mr C D Soar and Mr W Williamson, would shortly be published, and that the issue to subscribers for 1929 would be a volume on 'The Planktonic Diatoms of Northern Seas," by Dr Marie V Lebour A work on The Aquatic Stages of British Dragonflies, ' by Mr W J Lucas, was announced as being in preparation for publication at a later date

Among recent appointments in scientific and technical departments made by the Secretary of State for the Colonies are the following Mr G N Herrington has been appointed agricultural instructor in the Education Department, Nigeria Mr A W Anderson, recently one of the Ministry of Agriculture and Fisheries' advisory officers, is to be a superintendent of agriculture, Nigeria, and to take charge of the new stock breeding farm at Samaru Mr D A Langdon has been appointed a produce inspector, Nigeria, and Mr T D Lloyd Jones a veterinary officer in the same Colony Mr N R Reid has been appointed a veterinary officer in Tanganyika Territory Among the recent transfers and promotions are the following Mr J R Ainslie, senior conservator, to be deputy director of forests, Nigeria, and Mr C F Vetch, conservator of forests, Nigeria, has been appointed to succeed him as senior conservator Mr

D D'Emmerez de Charmoy, assistant director, has been appointed director of agriculture, Mauritius

MESSRS BERNARD QUARITCH, Ltd, 11 Grafton Street, W 1, have just issued an important catalogue (No 424) of some 1800 works relating to science, mainly of zoological and geological interest As is usual with lists circulated by this house, many rare items and long runs of serials are included The catalogue is one that should interest collectors and librarians

THE new catalogue of engineering and industrial instruments issued by Messrs Negretti and Zambra is a well illustrated quarto volume of 460 pages It deals to a large extent with thermometers of all kinds, from spirit thermometers to electrical thermometers, suitable for near or distant stations, and gives a considerable amount of very useful information about the principles on which they work and the precautions necessary in setting them up and caring for them in use Barometers, pressure gauges, tank gauges, hydrometers, and hygrometers receive similar treatment and a thumb index facilitates quick reference

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —Temporary assistant quantity surveyors under the Mines Department—The Under Secretary for Mines, Establishment Branch, Mines Department, Dean Stanley Street, S W 1 (April 18) An assistant bacteriologist for the city of Liverpool—The Town Clerk, Municipal Offices, Liverpool (April 22) A temporary assistant bacteriologist for research in fabric materials—The Secretary, Admiralty (C E Branch), Whitehall, S W 1 (April 27) An education secretary for the borough of Cambridge—The Town Clerk and Clerk to the Local Education Authority, The Guildhall, Cambridge (April 27) A chief assistant and two other assistants for the Scottish Society for Research in Plant Breeding under the Society's scheme of research into virus disease of potatoes—The Secretary, Scottish Society for Research in Plant Breeding, 3 George IV Bridge, Edinburgh (April 30) A lecturer in education in the University of Sheffield—The Registrar, The University, Sheffield (April 30) A lecturer in mathematics at the Heriot Watt College, Edinburgh—The Principal, Heriot Watt College, Edinburgh (May 1) An assistant at the Commonwealth of Australia Solar Observatory, near Canberra —The High Commissioner for Australia, Australia House, Strand, W C 2 (May 2) A junior technical officer at the Royal Aircraft Establishment, to assist in the experimental development of electrical equipment for use in aircraft—The Chief Superintendent, R A Establishment, South Farnborough, Hants (May 3) A principal of the Paisley Technical College —The Secretaries of the College, 3 County Place, Paisley (May 3) A demonstrator in physics, a demonstrator in zoology, and a demonstrator in inorganic and physical chemistry at Bedford College for Women—The Secretary, Bedford College for Women, Regent's Park, N W 1 (May 4) A director of museums of the City of Liverpool—The Town Clerk, Municipal Offices, Liverpool (May 7) A professor of zoology in the Egyptian University, Cairo—The Dean of the Faculty of Science, Egyptian University, Cairo (May 19) A laboratory assistant at the College, Cheltenham—The Senior Science Master, The College, Cheltenham

Our Astronomical Column

THE APRIL METEORS —These meteors are due on April 20 or 21, but the moon, being full on April 23, will be a bright object at the time and obscure small meteors However, the shower occasionally exhibits brilliant objects, so that it may be well worth looking for though the character of its display this year cannot be definitely foretold The period of revolution of its supposed parent comet was computed to be more than 400 years, but rich showers of Lyrids were witnessed in 1803, 1851, 1863, and other years, so that a short period apparently corresponds with some of the most abundant returns of the meteors It is important to note the strength of the annual displays, so that the time of revolution of its more active returns may be determined Its radiant is at 271° + 33° on the night of maximum, but the centre of radiation travels eastwards one degree per day

THE NUCLEI OF PLANETARY NEBULÆ —Mr van Maanen deduced the trigonometrical parallaxes of a number of nuclei of planetary nebulæ from photographs taken at Mt Wilson He derived the mean parallax 0 012″, and the mean absolute magnitude 8 1 for the nucleus Mr B P Gerasimovic notes in *Harvard Bulletin* No 864 that such data as exist for the proper motions and radial velocities of the planetary nebulæ indicate a considerably greater mean distance than that found by van Maanen. He makes several different estimates of their mean distance, (1) by their mean galactic latitude, which is assumed to be due to the sun's departure from the galactic plane, (2) by applying Oort's results on galactic rotation, (3) by using the analogy between the nebular nuclei and novæ, (4) by combining the proper motions found by van Maanen with the mean radial velocity of planetary nebulæ found at the Lick Observatory, which is 37 km /sec The mean absolute magnitudes found by these methods are 4 3, 4 6, 4 0, 5 9 respectively the weighted mean is 4 9, which is more than 3 magnitudes brighter than van Maanen's value, there is therefore good reason for thinking that his parallaxes for these objects are four times too large, though no explanation of this error has been found

THE ORBIT OF ETA CORONÆ —*Astr Nach* 5615 contains an exhaustive study of the orbit of this star by E Silbernagel, who has devoted himself for some years to the re determination of the orbits of binaries The duplicity was discovered in 1781 by Sir W Herschel, and as the period is less than 42 years, 3½ revolutions have been completed since then About 500 observations are employed, and the personal equations of the observers are determined The following is the final orbit:

T	1892 385	n	8 6490°
Ω	23 717°	a	0 907″
i	59 025		
ω	219·907		Period 41 623 y
e	0·2763		

Research Items

Festivals of the Hos of Kolhan.—Mr. D. N. Majumdar describes in the *Journal and Proceedings of the Asiatic Society of Bengal*, N.S., vol. 23, No. 3, the seven important worship festivals of the Hos which take place at different seasons of the year. It is noteworthy that in certain feudatory states in Orissa, where the Hos live in close association with the Oriya speaking peoples, while the latter take part in the festivals of the Hos, they are not allowed to take part in their dances, when men and women mingle freely, as intermarriage is not allowed. The festivals are not held at fixed dates, but depend upon economic conditions. When the granaries are full and the Hos are free from other engagements, the priest fixes a day for a festival, each village deciding for itself, so that any given celebration may extend over as much as two months, when the whole area of Kolhan is taken into account. The principal festival is the Maghe, which is held in January and February. Its meaning is obscure, but it seems to be connected with fertility. All villagers even if working in remote districts, must return to take part. It entails five days of ritual observances with *pujas* and sacrifices to the village deity. On the first day the sacrifice is connected with the cattle, on the second rice beer is offered by the priest and his wife. The third day is purificatory, in preparation for the marriage festival of the fourth day, which is the main function of the celebration. On this day the priest is escorted to take a ceremonial bath. He then sacrifices a cock and hen. A second hen, which is offered to the god, is not sacrificed by the priest, but is stoned to death by the villagers. In the dance which follows obscene songs are sung and obscene practices observed for the purpose of increasing the procreative power of the tribe. On the fifth day the expulsion of spirits takes place, when the villagers arm themselves with sticks, four or five feet long, and hunt the spirits throughout the village with invocations which are unintelligible even to themselves.

Early Persian Zoology.—The earliest exposition of Persian zoology is contained in a compendium of science, the "Nuzhatu-i-Qulûb," written by Mustaufi about A.D. 1340. One of the few extant zoological treatises of the Islamic East, apparently the only one the primary object of which was scientific rather than literary or philological, its chapters are of much interest as illustrating the level of zoological knowledge at the time and indicating the sources from which that knowledge sprung. In a learned treatise upon the subject (*Isis*, vol. 11, December 1928), Dr. John Stephenson traces the influences which are apparent in Mustaufi's zoology, gives examples of the treatment of real and fabulous zoology, of the bearing of the work upon medicine, and of the surgical uses of animals and their several parts. In an interesting comparison with European zoological works of the same period, he points out striking resemblances with the zoological text-book of Christianity in medieval times, the "Physiologus" and, since direct borrowing may be ruled out of the question, he regards these similarities as due to the descent of tradition from a common source. The general level of knowledge is much the same as that displayed by the thirteenth century English Franciscan, Bartholomew de Glanvilla, who borrowed from the "Physiologus," and, like the Persian author, had his mythical creations, mermaids, fauns, and satyrs, as well as more realistic monsters, such as the onocentaur, offspring of the bull and the ass.

Evolution of Human Tools.—An unusual study in human evolution has been made by Mildred Fairchild and Dr. Hornell Hart (*Scientific Monthly*, January 1929), in which they trace in a general way the development of cutting tools from the earliest chipped flints to the machines of the present day. The existence of such tools from the early stages of man's development affords the longest and most complete series of data available for the estimation of man's cultural progress. The tools present five variables upon which efficiency depends: (1) keenness and durability of the cutting edge, (2) differentiation and specialisation, (3) effectiveness of mechanisms employed to apply the blade to the materials to be cut, (4) utilisation of auxiliary power, and (5) mastery displayed in the technique of manufacture. Reducing these elements of efficiency to a numerical basis and combining all in a graph of progress, the authors produce a curve which, showing little rise over a long period, makes a sudden and rapidly increasing ascent during the past 8000 years. Whereas in earliest times thousands of years indicated the unit of progress, now each decade or each year shows swift advancement. The more and more rapid acquisition of new elements is not due to our lack of knowledge of early portions of the series; the increasing speed of invention is an unmistakable feature of the series itself.

Birds of Inner London.—Much has been written about the birds of London and the lists published by the committee in charge of the bird sanctuaries in the Royal Parks furnish useful notes on fluctuations of species from year to year. But no attempt has hitherto been made to compile a complete list of the birds which have been seen in Inner London as a whole. The area selected by A. Holte Macpherson for his interesting article on the subject (*British Birds*, March 1929) extends 2½ miles due north and south of Charing Cross and 4 miles due east and west of that point. Within this district the author is able to record a list of 126 species, of which 21 breed regularly, 8 others have been known to breed during the present century, and the remainder are visitors, 20 of which may be regarded as regular and 77 as putting in only an occasional appearance. Perhaps the most striking feature of the list is the variety of ducks and waders recorded. The occurrence of such as whimbrel, common and jack snipe, and woodcock, and of gadwall, scaup, and scoter, suggests that the mud banks of the Thames at low water may yet reveal further additions to the list, now that so satisfactory a basis has been laid for future observations.

New Aquatic Rodent from Africa.—Until the expedition organised by the Field Museum and the *Chicago Daily News* returned from its explorations in Abyssinia, only one aquatic rodent was known from Africa, namely, *Dasymys*. Now a second murine rodent, with rather pronounced aquatic modifications, has been found in a small mountain stream near the source of the Blue Nile. Its adaptations more closely resemble those of aquatic rodents in other parts of the world than of *Dasymys*, and since it shows no special affinities to the latter, the two African 'water rats' probably had independent origins. For this outstanding form Wilfred H. Osgood has created a new genus and species, *Nilopegamys plumbeus* (*Field Mus. Nat. Hist., Publication* 250, November 1928). Its particular adaptations for aquatic life are mainly in the character of the fur, the reduction of the external ears and the enlargement of the hind feet,

and in these respects it is reminiscent of the South American *Ichthyomys*, to which also it bears some resemblance in its skull But the skull is not greatly modified and the suggestion made is that the new 'water rat' may have been derived at no very remote period from one of the common types widely distributed in central Africa

GRAFTING EXPERIMENTS IN TWO DAY CHICKS — P D F Murray (*Aust Jour Exp Biol*, vol 5, part 4, Dec 1928) has made chorio allantoic grafts of lateral pieces of two-day chicks, taken from the region forming the posterior limb by making an anterior transverse cut posterior to the hindmost somite then formed, a posterior cut in front of the anterior end of the primitive streak, a longitudinal median cut lateral to the vertebral plate The grafts show cartilaginous structures interpreted as attempts at limb formation, and it is concluded that no essential influence is exerted by the somites on the development of limbs, and the author adduces reasons for the view that if the limb rudiment at two days could be completely isolated self differentiation would occur, that is, the rudiment of the hind limb is already determined at this stage The nervous system exerts no essential influence on the development of the limbs of the chick In three cases the endodermal and splanchnopleural components of the grafts have given rise to short pieces of intestine with epithelium, corium, circular and longitudinal muscle layers, hence small pieces of the region of the alimentary tract are able to develop in the absence of the other regions of the tract

INTESTINAL MUSCLE OF THE CRANE FLY —S Maziarski (*Bull. Int Acad Polonaise Sc Lettres*, 7 B, 1928) has investigated the histology of the muscle of the alimentary tract of several species of *Tipula* (crane fly) Opinions as to the nature of the muscular elements—whether they are smooth or striated—have been contradictory, but the author states that undoubtedly all the muscular elements of the intestine are in the category of striped muscle All the contractile elements and their ramifications by which they anastomose exhibit a characteristic longitudinal and transverse striation, the longitudinal due to the myofibrillæ in the sarcoplasm The elongate muscular elements, each with a single nucleus and a sarcolemma sheath, exhibit numerous ramifications either terminal or lateral, some short and others apparently composed of a single myofibril, which anastomose directly with neighbouring fibres to form a network The anastomosis always takes place at the level of the membrane of Krause, which confirms the view already expressed by many other histologists that this is distinct from the contractile substance and represents a more plastic and more resistant supporting material The intimate relations between the fibres (cells) suggest that the contractile elements have lost their individuality and form a muscular syncytium

COTTON —The reports received from experiment stations during 1927–28 have been issued by the Empire Cotton Growing Corporation in a bulky volume of some 270 pages, plus photographs, diagrams, etc This lengthy document is preceded by a very valuable, concise summary of its contents by Dr J C Willis Dr Willis points out the inevitable difficulty of the field experimenter in that his rainfall practically always departs from the average (and the same may be said of every measurable climatic factor), and thus in the twenty climatic records from ten cotton experiment stations in the last two seasons, five may be classed as good years, ten medium, and five bad Some experiment stations are probably situated in climates which are not well suited for existing varieties of cotton, and here, as at Fiji, where the weather is probably unusually wet for cotton, something may be done by hybridisation and selection to produce a new variety more suitable to the climate In South Africa, the immediate problem has been the production of a variety showing resistance to the jassid pest, and remarkable progress appears to have been made with the selection and multiplication of suitably resistant strains These strains, developed at the Barberton Station, seem likely also to be successful in Rhodesia In Queensland good progress seems to have been made in dealing with the pink boll worm, whilst in Fiji it is very interesting to learn that the boll worm pest is apparently kept in check by its parasitic enemies Boll shedding before the crop is mature is often a great source of trouble with cotton, and in Uganda definite progress seems to have been made with the breeding of varieties with lower rates of boll shedding All who are interested in any phase of the field study of the cotton plant its growth the control of its parasitic enemies the breeding of new strains, etc, will find the Report of interest and value It is published by the Empire Cotton Growing Corporation, Millbank House, Millbank London S W 1

GLADIOLUS —The wide range of species of *Gladiolus* in South Africa is illustrated to some extent in the beautiful coloured plates accompanying the article by Mrs Bolus on this genus in the *Journal of the Botanical Society of South Africa* part 14, 1928 In the notes on p 3 of the same journal attention is directed to the horticultural possibilities that are suggested by experiments in hybridisation with some of this species Thus at present there are no scented and no blue forms among the *Gladiolus* hybrids under cultivation whilst amongst the South African species blue flowered ones occur and some of the wild species have a powerful and delicious fragrance Such hybridisation experiments would seem very suitable work to be carried out at the National Botanic Gardens Kirstenbosch, but unfortunately the income of the Gardens does not permit the possession of any scientific or technical staff whatever so that such experiments in the Gardens could only be carried out to the detriment of other work In the same number of the journal, Mr J W Mathews, curator of the Gardens, contributes some notes on the cultivation of the native South African gladioli

NEW PROJECTION FOR WORLD MAPS —In the *Geographical Journal* for March, Mr S W Boggs describes a new equal area projection that should be useful in statistical maps It is an equal area projection which is an arithmetical mean between the sinusoidal equal area projection of Sanson and the elliptical equal area projection of Mollweide Inequality in linear scales near the equator is scarcely noticeable, and the same is true between latitudes of, say, 60° and 75° This feature is an improvement on Mollweide Angular distortion is less than in Sanson in latitudes below 62°, above 68° or thereabout the angular distortion is less than in Mollweide The author describes it as a eumorphic equal area projection He points out that this projection, like those of Sanson and Mollweide, having straight parallels and converging meridians, lends itself to 'interrupted' construction in gores or lobes which much enhances its value for distributional maps

EARTH MOVEMENTS IN CALIFORNIA —The United States Coast and Geodetic Survey is continuing its researches into earth movements in the western United States by comparing the position of stations as determined by old and new triangulation In *Special Publication* No 151, Dr W Bowie discusses the results

of recent work in California The comparison is generally between determinations made prior to 1900 and those made between 1922 and 1925 Many stations show no movement The greatest movements have occurred close to the fault line of the earthquake of 1906 Stations more than twenty miles from the fault were affected but only slightly The differences are small and seldom exceed one metre The trend of the changes is to the south eastward, on the east of the fault where they are most noticeable Dr Bowie suggests that investigations of this nature should in the future be done by means of short arcs of triangulation extending across the fault line or zone to a distance of about twenty five miles on both sides The accuracy can be made great enough to detect movements of about one tenth of a foot in a mile He prefers this method to that of measurements between monuments placed across the fault zone in a straight line This plan involves the difficulty of measuring with tapes over broken ground

INDIAN JURASSIC AMMONITES —The third part of Dr L F Spath's 'Revision of the Jurassic Cephalopod Fauna of Kachh (Cutch)" (*Palæont Indica*, N S, vol 9 mem 2, pp 163 278, plates 20 47, 1928) deals with the super family Stephanoceratidæ, represented by about 500 specimens This is divided into five families the Macrocephalitidæ with 7 genera, the Eucycloceratidæ with 4 genera, the Pachyceratidæ with 2 genera, the Mayaitidæ with 5 genera, and the Reineckeidæ with 6 genera

JAPANESE PALÆONTOLOGY —The rich fauna of the Lower Tertiary of the island of Kyushû, Japan, has been described by T Nagao (*Sci Rep Tôhoku Imp Univ Sendai*, ser 2, Geol 12, 1 1928, pp 11 140, plates i xvii) It consists mainly of lamellibranchs and gasteropods, but some foraminifera, echinoids, nautiloids crabs, and fishes are also found Three horizons are recognised The lowest is regarded as Ypresian or Lutetian in age, the middle as Upper Eocene, the upper as Oligocene In the same publication (pp 141 152 plates xviii xxiii) H Yabe and S Toyama give an account of the rock forming algæ from the Jurassic and Cretaceous deposits of Japan Some of the species are referred to genera found in England (*Girvanella, Solenopora*), others belong to new genera

VACUUM TECHNIQUE —Several attempts have been made to find a substitute for mercury for use in high vacuum pumps, but they have not hitherto met with any conspicuous success metals other than mercury have undesirable properties, and it had been thought that organic substances were too liable to decomposition to be of use C R Burch, of the Metropolitan Vickers Company, states, however, in the issue of the *Proceedings of the Royal Society* for Mar 6, that it is possible to run a condensation pump satisfactorily with some of the fractions obtained in the vacuum distillation of petroleum jelly, when both the speed of pumping and the degree of vacuum reached compare favourably with those obtained when mercury is employed The petroleum products have the additional advantage that their vapour pressures are decidedly less than that of mercury at room temperatures The author has also isolated a number of greases, the vapour pressure of which is less than a microbar at 300° C, which should be extremely valuable for the lubrication of ground joints in vacuum apparatus which does not require to be heated

STARK EFFECT —Prof Stark's discovery of an electrical analogue of the Zeeman magnetic effect for spectral lines, although less widely applied in spectrum analysis, has recently become of importance in connexion with the wave-mechanics The distribution of intensities in the Stark patterns for the Balmer series of atomic hydrogen has been predicted by Schrodinger, and experiments to test his theory have now been made by J S Foster and L Chalk (*Proceedings of the Royal Society*, Mar 6), and by H Mark and R Wierl (*Zeitschrift fur Physik*, Feb 25) Dr Foster has made use of the natural electric fields in the cathode dark space of a discharge tube, and finds distributions of intensities which agree with those predicted by theory The other investigation was made upon the light emitted from a beam of positive rays passing through an auxiliary electric field, and the agreement between theory and experiment is less good The origin of these discrepancies is not clear, but it may be, as H Mark and R Wierl suggest, that the experimental conditions employed do not conform completely with those contemplated in the theoretical analysis Dr Foster has contributed a second paper, on the Stark effect in neon, to the same issue of the *Proceedings*, which also contains a paper by J K L MacDonald on the Stark effect for some lines in the violet part of the secondary spectrum of hydrogen

COMBUSTION OF CARBON MONOXIDE —Prof W A Bone s experiments on the combustion of dry mixtures of carbon monoxide and oxygen have been subjected to a certain amount of criticism on the grounds that inadequate precautions had been taken to remove occluded hydrogen from the platinum electrodes between which the igniting spark was passed These objections appear to have been met satisfactorily in the reply which he has published in the issue of the *Proceedings of the Royal Society* for Mar 6, and some new experiments which are described there, in which the drying was, if possible, even more drastic than before, confirm his earlier result that the intensively dried mixture can be induced to react if only sufficient energy is supplied to initiate the explosion wave Prof Bone and his collaborators consider that the limit of intensive drying by phosphorus pentoxide is reached in about six months in small glass vessels such as those they have employed The energy required to start the explosion seems to depend both upon the nature of the electrodes used and upon the composition of the detonating mixture, but the numbers which are mentioned in this paper are all in the neighbourhood of one joule

ACTION OF ACETYLENE ON SELENIUM —Only very few accounts of experiments on the direct action of non metallic elements on organic compounds have as yet appeared in chemical literature The formation of thiophthen, $C_6H_4S_2$, by the interaction of acetylene and molten sulphur was observed by Capelle and confirmed by Oechsner de Coninck (1908), whereas, according to Meyer and Jacobson's "Lehrbuch," Sandmeyer established the formation of thiophen under such conditions In the *Rendiconti* of the Naples Academy of Physical and Mathematical Sciences for September–December 1927 (just received), Mazza and Solazzo give the results of an investigation on the action of acetylene on selenium Passage of the pure, dry gas over selenium heated to 250° 300° C yields an oily product, which may be resolved by fractional distillation into two compounds (1) Selenophen, C_4H_4Se, b pt 113° 114°, which is identical with the product obtained by Foà in 1909 by the action of phosphorus selenide on sodium succinate, (2) a new compound, selenonaphthen, C_8H_6Se, m pt. 53° 54°, b pt 207° 209°, which is the selenium analogue of thionaphthen and has an intensely nauseous odour This compound crystallises well and forms a golden-yellow, crystalline, slightly soluble picrate.

Research on Water Pollution

A COMMITTEE has been set up, under the chairmanship of Sir Horace Monro, to deal with the legislative and administrative aspects of questions relating to river pollution This committee considers that present legislative enactments are sufficient, and recommends the setting up of River Boards in the various watersheds of England Such Boards, having a call upon the rates, would be in a financial position to apply the laws against pollution, a costly activity which rarely appeals to private individuals They would be in a position to employ a technical adviser conversant with local conditions and with known means of dealing with noxious effluents It remains to be seen whether county councils will act on this advice and set up a series of Boards throughout Great Britain, similar to that in the West Riding of Yorkshire

Although much has been done recently in surveying rivers and locating sources of pollution, many of which could be stopped or at least ameliorated without putting undue burdens upon the rates or upon individual industries, there are also numerous questions which, in the interests of the public, have still to be worked out

With this aim in view, the Water Pollution Research Board was formed in June 1927, with Sir Robert Robertson as chairman and Dr H Calvert, chemical Inspector of the Ministry of Health, as part time director of research They have undertaken the three fold task "To collect and collate all pertinent scientific and technical information, so that it may be readily available for practical application by those who are concerned with water supply and the disposal of polluting liquids, to encourage and co ordinate relevant scientific research in this country, and to undertake such investigations as are necessary in the public interest and not otherwise provided for"

A good start has been made The monthly summaries of current literature, of which some seventy copies are distributed, are excellent and will be of material assistance not only to those concerned with water purification and wastes disposal but also to many workers in hydrobiology In the report of the Board for the year 1927–1928 (H M Stationery Office, 6*d*) an account is given of investigations now proceeding and of plans for the near future

The disposal of effluent waters from beet sugar factories presents a problem which had early in the year been 'farmed out' by the Ministry of Agriculture and Fisheries for investigation at Rothamsted Each factory uses some 3½ million gallons of water daily, of which nearly half a million gallons are discharged containing putrifiable matter comparable to 0 2 per cent sucrose It is found that by sprinkling this water over a biological filter at a rate of 100 gallons per square yard daily, its putrescibility is reduced by some 80 per cent Trial filters were erected at the Colwick factory and filled with different media Two were seeded with active growth from a sewage filter, but this inoculation had no observable effect on the maturing of the filters The growth on coarse gravel consisted of thickly matted fungi, while on the finer media the growth was soft and composed chiefly of bacteria, the flora and fauna on the filters differed and were distinct from the flora and fauna of ordinary sewage filters The purification attained cannot be regarded as sufficient to meet the most exacting requirements, but still better results are expected from the past winter's campaign.

It is anticipated that the effluents may be made fit for re use in the factory, a practice which is already in operation in some cases, so that the daily discharge into the rivers will be reduced to a reasonable amount for treatment on biological filters

A biologist has been appointed to work under the direction of Prof Topley at the London School of Hygiene and Tropical Medicine, on the processes involved in the treatment of sewage by 'activated sludge' The solids of sewage after aeration become capable of flocculating colloidal matter and removing dissolved organic substances from further volumes of sewage In doing so the aerated solids, or 'activated sludge,' lose their activity, which can however, be restored by further aeration There is however, little exact knowledge of the process and it is yet uncertain whether it is physico chemical or the direct effect of micro organisms The de watering and the production of gas from sludge or sewage also engage the attention of the board

It is considered that a general biological and chemical survey of a typically polluted river would furnish information of general value as well as local information Such a survey should yield much new knowledge of river conditions generally of the interaction between the river and the various effluents —their direct or indirect effect upon the flora and fauna The Tees is suggested as a suitable watershed, the river having been under examination for several years and useful data already collected Undoubted damage has been done by pollution, but the nature of the damage and the various causes still offer a wide field for investigation

In all these matters the main part is played by micro organisms—the unpaid scavengers of every borough How they are best harnessed to destroy unwanted organic matter most efficiently, and even to break down naphthalene in coke oven effluents, provide outstanding problems

Compared with some continental countries, England is behindhand in providing facilities for the general study of freshwater biology and hydrology These subjects are no longer of academic interest only, for they enter into many economic problems within the Empire Mosquito control and tropical lake fishery investigations, for example, are in present need of information and recruits, which should normally come from an English freshwater biological laboratory, similar to the marine laboratory at Plymouth, where more than twenty visitors are at times working on varied researches during the university vacations That the Rivers Pollution Research Board will act as a valuable clearing house for information is assured We hope it may encourage the institution of a laboratory for post graduate workers near pools, lakes, and a river—a facility for which there is a present demand The study of aquatic life and of the breakdown of organic matter by micro organisms is not merely of domestic interest

The Board has also arranged for the investigation of the softening of water by the process in which it is allowed to trickle through beds of natural or artificial zeolite containing sodium in chemical combinations The sodium is displaced by the calcium and magnesium of the hard water, and the beds are finally rejuvenated by displacing the calcium and magnesium held by them with a solution of common salt The mode of action of the base exchanges is very imperfectly understood from the physico chemical point of view The process is in extensive use, but is little used by water supply authorities as yet

High-Voltage Alternators for the Grid

THE developments of engineering seem to be unending The manufacturer craves after mass production and standardisation, but his wishes are seldom gratified The progress of development sooner or later necessitates change One of these changes was pointed out by Sir Charles Parsons and Mr J Rosen in a paper read to the Institution of Electrical Engineers on Mar 21 They give in their paper reasons for thinking that very high voltage generators can be made which can be directly connected with the grid network without the necessity of using transformers The possibility of making very high voltage alternators has been known for many years So far back as 1905 the engineers of the Ganz company constructed several 30 000 volt alternators for use in the hydroelectric power station at Subiaco, 34 miles from Rome Credit must be given to the engineers for this early pioneering work, and the successful running of these machines show that they had overcome the difficulties of insulating these high voltages

Engineering history often illustrates the change of procedure brought about by new developments In the early days of marine propulsion, for example, the use of step up gearing between the prime mover and the propeller was a necessity When triple expansion reciprocating engines came into use it was found possible to operate without gearing For modern steam turbines and some types of Diesel engine speed reduction gears are now necessary Just as mechanical gear forms the link between the engine and the propeller so in electrical power distribution at high pressure the transformer has for many years been a necessary link between the generator and the network and also between the network and the lighting and motor load

Sir Charles Parsons and Mr Rosen propose to abolish the step up transformers by using very high voltage generators which can be connected directly with the mains

They point out that the continually increasing size of the generator units now make the conditions favourable to the introduction of these generators They consider the design of a 94 000 kilovolt ampere, 11,000 volt, three phase generator In this case the current at each terminal is about 4900 amperes Much space is required to accommodate the many cables mounted below the alternator terminals in a cable tunnel through the concrete With so many cables grouped together difficulties are experienced with the girders which reinforce the concrete The maximum output from the cables also is rarely obtained The authors show that not only are most of these difficulties overcome but considerable economies are also effected by using an alternator of a higher voltage If the pressure is increased to 33 kilovolts, the output current is reduced to 1640 amperes, and instead of six cables per phase only two are required

One great advantage of raising the pressure is the reduction in the cost of the leads and switchgear which it effects In very large units the enormous currents developed are very difficult to control and operation becomes almost impossible The General Electric Co of Schenectady when designing a 208,000 kilowatt unit for the State line station near Hammond, Ind , found it necessary to reduce the current This was done by raising the pressure from 18 to 22 kilovolts

Details are given by Sir Charles Parsons and Mr Rosen of the design of a 33,000 volt, 25,000 kilowatt alternator which has been working at the Brimsdown power station in north London since August 1928 A very novel feature in the design is the use of triple concentric mains for the armature conductors By this means they are able to reduce the maximum electric stresses to which the dielectric would otherwise be subjected This formation of conductor also is mechanically very strong The three conductors are called the bull inner, and outer ' respectively The bull conductors of each phase are connected in series, they are then connected with the 'inners' in series and finally with the outers The whole arrangement is connected in star and the star point is connected with the earth

The test results obtained with this machine were very satisfactory The shape of the voltage wave was practically the same as that of a sine curve The machine when running at its normal speed of 3000 revolutions per minute was suddenly short circuited The short circuit current was less than five times the normal full load current It seemed to function satisfactorily under these conditions the end conductors showing no sign of having moved mechanically The efficiency on a load of 25 kilowatts was 96 5 per cent Even when the load was so low as 10 kilowatts the efficiency was 93 5 per cent For the last six months it has operated continuously up to its maximum load at voltages varying from 34 to 35 kilovolts, and it has withstood without showing any sign of distress the sudden loads thrown on it when severe faults have developed on the large overhead and underground network to which it is coupled

The first step in the process of getting rid of the step up transformers connecting the generators to the grid network has been made The standard pressures of transmission in Great Britain are 33, 66, and 132 kilovolts Manufacturers can now make 33 kilovolt generators, and doubtless 66 kilovolt generators will soon be made In the meantime, however, these pressure generators can be advantageously used on 33 kilovolt circuits Although the authors in this paper confine themselves to high voltage generators, it is obvious that the ever increasing size of motors, motor generators, and synchronous condensers will enable them soon to be economically designed so as to be coupled directly to the network without the use of intermediate transformers Sir Charles Parsons and his associates are to be congratulated on having initiated a new and very promising development in electrical engineering

The New Acoustics [1]

RAYLEIGH S Theory of Sound, ' published more than fifty years ago, may be taken as representing the whole range of the physical acoustics of that period, and the much enlarged second edition, published eighteen years later, gave, in conjunction with Helmholtz's 'Sensations of Tone ' a fairly complete view of the acoustics of a generation ago Subsequent treatises have followed the classical methods thus established, and show little trace of the revolution which has occurred during the past decade in consequence of the influence of electrical theory and practice These changes have been stimulated by needs arising partly out of the War, but still more out of broadcasting

On the experimental side, much new apparatus of an electrical character has become available The

[1] Summary of presidential address delivered to the Physical Society Mar 22, 1929 by Dr W H Eccles F R S

condenser microphone enables sound to be converted into its equivalent electrical current with the minimum of distortion and, in conjunction with the triode amplifier, enables vibrations to be detected and measured which, though of audio frequency, are inaudibly weak The triode can also be used for the production of sounds the amplitude and frequency of which are widely variable and can be maintained very constant The electric filter circuit has provided a powerful method of purifying and sifting oscillations of mixed frequencies The conversion of sound into electrical oscillations enables the whole range of electrical methods of measurement to be used

On the theoretical side, the technique which has been developed for the study of impedance networks has been applied to the solution of acoustical problems For example, the squeaking of a slate pencil is analogous to electric relaxation phenomena, such as the flashing of a shunted neon lamp

Architectural acoustics has benefited by the availability of loud, filtered monotone sounds and distortionless sound detectors The decay of sound due to absorption in the walls of an auditorium, first studied by Sabine, has been accurately measured by electrical methods, with great advantages for the regulation of reverberation in buildings, both by architectural design and by the development of sound proof materials

In the realm of physiological acoustics, such interesting facts have emerged as that a change in intensity of a monotone must reach ten per cent to be noticeable Accurate results have also been obtained for the range of pressure and amplitude within which a sound must lie to be audible, and for the masking of one sound by another of different pitch

One practical outcome of these researches has been the development of public address apparatus, by means of which an orator can address an audience of a million persons Many problems of distortion have had to be solved in the working out of this apparently simple system, which comprises a microphone, amplifiers, and loud speakers The intensities of the sounds to be dealt with vary in the ratio of 1 to 1500 in the case of speech and 1 to 100,000 in the case of music; and it is found that if all the harmonics of a given sound be amplified equally, the resultant sound appears to be distorted, owing, presumably, to the non linear response of the ear

Conceptions and nomenclature developed in connexion with electrical impedance networks have been carried over into acoustics The 'motional impedance' of a telephone diaphragm was implicitly recognised in earlier works, but in the hands of Kennelly and Pierce, who introduced the nomenclature, Hahnemann, Hecht, Webster, and others, the representation in electrical terms of the inertia, resilience and energy dissipation in mechanical parts has yielded valuable results Thus, it has been found that the impedance of a horn approaches pure resistivity (yielding maximum efficiency) at frequencies above a lower cut off frequency which is very much lower for an exponential than for a conical horn The conception of motional impedance can be applied to clarify substantially the design of complicated electro acoustic combinations such as that which is constituted by a loud speaker a detailed example was given by the lecturer

In measuring the subjective loudness of sounds, telephone engineers have introduced the conception of the 800 cycle standard mile this corresponds to the difference in aural sensations derived from telephones at the beginning and end of a mile of standard cable at 800 ~, and roughly to a 25 per cent difference in power It has consequently been proposed that the increase ratio $10^{0 \cdot 1}$ or 1 259 of power should be standardised for all frequencies, this ratio being known as a 'transmission unit' Thus, if the power of an auditory stimulus were increased 1000 times, the sensation would increase by 30 transmission units Since pitch also increases according to the logarithm of frequency, the most human way of representing acoustical relations graphically is to plot transmission units against the logarithm of the frequency

The address concluded with a suggestion that the new acoustics should find a place in college courses and examination syllabuses C W H

Natural Hybrids in Plants

SINCE Darwin directed attention to the problem of the evolution of a species, there has been considerable interest in the extent to which the individuals of such a species form fertile offspring when crossed with other organisms not included in the species Obviously, if such attempts at hybridisation were ineffective under natural conditions or yielded infertile offspring, then the maintenance of the species as a distinct race was readily intelligible, however difficult it might be to understand how varieties crossing readily with one another had in course of time devolved into distinct species which had lost the power of interbreeding

During the recent discussion upon natural hybrids of plants at the Linnean Society of London on Feb 28, the president, Sir Sidney Harmer, and Mr M A C Hinton, pointed out that amongst the wild mammals, naturally occurring hybrids are almost unrecorded It will be remembered that Huxley always regarded this property of fertility within its ranks and failure to breed outside them as one of the most characteristic features of the natural species, and therefore as the outstanding feature which distinguished it from a race of cultivated animals or plants produced by artificial selection The latter is often as distinct in structure and form as many a good natural species, but continued to breed freely with other races within the same domesticated species

Darwin in the "Origin" clearly recognised that natural affinity, as expressed in a natural classification, included the sum of all characteristics of the organisms, including those connected with fertilisation mechanisms, so that natural affinity was usually an index to capacity to interbreed As a general rule, therefore, varieties crossed more freely than species, and species than genera, yet the diverse factors associated with reproduction in the organism varied from type to type so that some varieties failed to interbreed, whilst in other cases genera might yield intergeneric hybrids and species would only ripen seed if crossed by foreign pollen

Since the days when the significance of these natural hybrids to the study of evolution were grasped, our knowledge of their occurrence has considerably advanced, as was well illustrated by the discussion at the Linnean Society Dr A W Hill dealt with the New Zealand flora, in which some 290 groups of wild hybrids have now been noted, belonging to 42 families and 92 genera In some genera, as *Phormium*, which includes the New Zealand flax plant, these plants open up questions of great economic importance

A remarkable series of *Gaultheria* hybrids were exhibited by Dr Hill, which showed a gradual transition from *G oppositifolia* to *G antipoda* and *G rupestris*, and thence to *G perplexa*, also series between *G perplexa* and *antipoda* and *rupestris* and

antipoda The species *oppositifolia* and *rupestris* have a dry capsular fruit without fleshy calyx segments, in *antipoda* the calyx becomes thick and fleshy as the fruit ripens, whilst in *perplexa*, in addition, the fruit is a fleshy berry Most of these hybrid Gaultherias produce viable seeds Messrs E M Marsden-Jones and W B Turrill described genetical experiments and field observations on certain British genera They conclude that the polymorphism of such a genus as *Centaurea* owes much to hybridisation, which is thus one, but only one, of the factors in organic evolution

Prof C E Moss described some of the natural hybrids of *Clematis*, *Anemone*, and *Gerbera* occurring in the Transvaal The study of such natural hybrids leads Prof Moss to the conclusion that bigeneric hybrids occur in Nature and may be fertile Similarly, fertile hybrids occur between well defined species Hybrids of either of these classes are not common, they are often striking plants and are easily detected On the other hand, between closely allied species, fertile hybrids may readily occur in abundance and may give rise to that polymorphism in some groups of species which is so perplexing to the systematist Prof Moss stated that he had met no case of the occurrence of natural hybrids in the field, which led him to think that natural hybrids gave rise to species

Dr Lloyd Praeger pointed out that, of some fifty species of *Sempervivum* in the Canary Islands, some thirty five were known to hybridise, amongst the hybrid offspring barrenness is very general Dr O Stapf, speaking from the point of view of a systematist, agreed that hybrids are abundant in many plant families in Nature, and thought that the isolation of a hybrid progeny may lead to the appearance of a new species

Dr J P Lotsy is the champion of the theory that hybridisation is the main instrument of species evolution, and Dr C L Huskins pointed out that this theory includes the possibility of 'hybridisation' within a single nucleus Obviously the problem will in the future be taken further as this wealth of natural hybrid material is submitted to cytological examination, the data as yet available from such cytological work were utilised by Dr E J Collins in his contribution to the discussion

University and Educational Intelligence

Applications are invited by the London County Council for two Robert Blair fellowships, each of the annual value of £450, tenable for one year The fellowships are for advanced study or research in applied science and technology, and are tenable in the Dominions, the United States or other foreign countries Further particulars and application forms (T 3)/300 may be obtained from the Education Officer (T 3), The County Hall, S E 1 The completed forms must be returned by June 18

The St Andrews Committee for the Training of Teachers is organising a summer school, to be held at the United College, St Andrews, on July 8–26 Courses of lectures on modern advances in physical science, by Prof H Stanley Allen, on the teaching of physics and chemistry, by Messrs J W Bispham and R H Dickinson, and on rural science, by Mr M R Gillanders, are included in the programme Particulars can be obtained from the Director of Studies, Training College, Park Place, Dundee, applications to attend must be sent in not later than May 1

The recently published Annual Report of the Carnegie Trust for the Universities of Scotland is of more than ordinary interest, including, as it does, statements showing the working during the five years 1923–28 of the Trust's various schemes for encouraging the pursuit of scientific research Under the scheme of postgraduate study and research, which has been in operation for twenty five years, 478 awards were made in the quinquennium at a cost of £51,047 Closely associated with this scheme is the provision made by the Trust since 1923–24 for 'teaching fellowships' for university lecturers and assistants, who hold them subject to the condition of devoting not less than half their time to research Forty one such fellows have been at work at a cost to the Trust of £20,023 Detailed reports, classified under subject headings, of the work done under these schemes and of researches, subsidised by the Trust, in the laboratory of the Royal College of Physicians, cover about eighty pages Of more general interest are the reviews by the Trust's expert advisers Reviewing the work done in (1) physics and chemistry and (2) biology and medicine, Profs Arthur Smithells and J T Wilson both comment on the increasing demand for scientific assistance in industrial concerns There is a greater demand for trained chemists than has ever been known in Great Britain, and the lure of industrial appointments has led in many instances to the curtailment of the period of tenure of fellowships and scholarships The Trust's research schemes function, says Prof Wilson, as a sort of unofficial Scottish staff college for research, from which are recruited personnel not only for university staffs, but also for staffs of other public laboratories and institutions They cost the Trust £82,700 during the quinquennium Its grants to universities and extra mural institutions for 1925–30 amount to £231,225, assistance to Scottish students in the payment of university class fees in the one year 1927–28 amounted to £57,772

The University of Leeds gives, in its report for 1927–28, an account of important additions, costing upwards of £150,000, to its buildings Increased accommodation was thus provided for the medical, dental, mining, and textile departments and for the residence of men and women students Plans were also approved for new buildings for the physics and chemistry departments Statistical tables appended to the report show that during the five years 1923–28 the number of full time day students has continuously declined from 1475 to 1296 It is, however, still nearly twice the number (663) in 1913–14 The decrease in 1927–28, compared with the preceding year, was chiefly among men students in the faculties of technology and medicine, and women students in the faculty of arts Facilities for research were substantially increased during the year, notably by (1) the acquisition of an estate suitable for the pursuit of cancer research, and including a convenient residence for the professor of experimental pathology, (2) a grant by the Clothworkers' Company of £3000 a year for four years, enabling the University to appoint a lecturer in textile physics with a research assistant and to award eight fellowships for investigators in the textile industries and dyeing departments, (3) the recognition of researches conducted in the laboratories at Torridon of the British Research Association for the Woollen and Worsted Industries as qualifying for the University's research degrees It has been decided to publish annually, in a separate pamphlet, short summaries of unpublished research work and references to published work accepted for higher degrees, and to include in the pamphlet the list, hitherto published as an appendix to the annual general report, of works, original papers, etc, by members of the University Among gifts to the University during the year was one by Messrs Briggs, Son and Co, of a scholarship of £150 a year for five years, tenable in the Mining Department

Calendar of Patent Records

April 14, 1720 —The 'stoving' process of seasoning timber for shipbuilding—in which the timber is heated in wet sand—was the invention of John Cumberland, whose patent is dated April 14, 1720 The process, which was reported by the Admiralty to be much superior to the old method of charring that it displaced, was used in the Royal dockyards for some years, an allowance of £200 a year being guaranteed to the inventor An application for a prolongation of the grant was dismissed

April 17, 1882 —The 'telpher' system of transportation—in which goods are carried by electrically operated and automatically controlled trolleys travelling on a mono rail—was the invention of Prof Fleeming Jenkin, his patent being dated April 17, 1882 The first commercial installation in England was opened in 1885 for carrying clay from the pits at Glynde in Sussex to the railway

April 18, 1707 —On April 18, 1707, there was granted to the first Abraham Darby a patent for his invention of "casting iron bellied potts and other iron bellied ware in sand only without loam or clay," which greatly increased the use of iron for founding purposes Previous to this invention, such articles were only made in the more costly brass, iron castings being confined to the production of simpler articles such as fire backs and grave slabs Abraham Darby's name is an honoured one in the history of the iron industry, for it was he who, about 1710, first discovered and put into practice a satisfactory process for the smelting of iron with coke

April 18, 1818 —The omnibus dates from the French patent granted to De Berckem of Paris on April 18, 1818, for what he called a 'Parisienne,' carrying eighteen persons A previous attempt—with which Blaise Pascal was associated—had been made to run public vehicles of this kind in Paris, but it was not successful and was soon abandoned

April 18, 1838 —William Barnett's patent, dated April 18, 1838, is an important milestone in the history of the gas engine, for it was in this that the advantages of compressing the combustible mixture before igniting it were first pointed out In Barnett's engine the air and gas were compressed separately and were mixed in the cylinder at the beginning of each stroke A special ignition cock, which remained long in use, was also a feature of the invention

April 18, 1885 —One of the early suggestions for utilising the principle of the gyroscope to replace that of the magnetic needle in the mariner's compass was the invention of two Dutchmen Gerardus van den Bos and Barend Janse, whose German patent was applied for on April 18, 1885

April 19, 1758 —The achromatic telescope of John Dollond was patented on April 19, 1758 No action seems to have been taken by the Privy Council on a petition signed by most of the instrument makers of London, alleging that object glasses in accordance with Dollond's patent had been made and publicly sold before the date of the grant and praying for the revocation of the patent, and the patent was afterwards upheld in the Courts in an action for infringement But there seems to be little doubt that Chester Moor Hall was the first inventor

On the same day, April 19, 1758, there was granted to Jedediah Strutt a patent for the rib stitch hosiery frame, which was the first important modification of Lee's stocking frame Strutt invented the rib stitch machine for his hosier brother in law, William Woollatt, and the two started what became very successful works at Derby and Nottingham

Societies and Academies

LONDON

Mineralogical Society, Mar 19 —**A W Groves** and **A E Mourant** Inclusions in the apatites of some igneous rocks Apatite crystals with dark cores of inclusions have been observed among the heavy minerals of some English sedimentary rocks, but there are few records of such apatites in igneous rocks The authors record several such occurrences in granites and in volcanic rocks from Normandy, Jersey, and Brittany Five different types are distinguished in the granite of northern Brittany alone In one type with a definitely pleochroic core the inclusions appear to consist of biotite or chlorite, but in other types it has not been possible to determine their nature —**L A Narayana Iyer** Calc gneisses and cordierite sillimanite gneisses of Coimbatore, Madras Pres, and similar occurrences in India The paper dealt with a suite of crystalline gneisses in the ancient Archæan complex of India of Dharwar age (Huronian), consisting of the above two facies which are in close association Similar suites of rock occur in different parts of India, forming a definite stratigraphic horizon The author considers their formation as due to thermal or 'infra plutonic' metamorphism followed or accompanied by regional or dynamo thermal metamorphism of pelitic schists and calcareous sediments —**F A Bannister** A relation between the density and refractive index of silicate glasses with application to the determination of imitation gem stones The study of simple glass families leads to a relation between the refractive index and density which can be applied in a modified form to the determination of imitation gem stones $(n-N)/(d-D)$ where N and D are the refractive index and density of silica glass, is plotted against n by a simple graphical method, whereupon the various imitations separate into groups, the members comprising any one group are chemically similar Doubtful cases can be solved by measuring in addition the relative dispersion —**H E Buckley** The crystallisation of potash alum The author described the results of experiments on the differences of crystal habit obtained under varying conditions of cooling and evaporation, and in the presence of various substances in solution such as strong acids, $AlCl_3$, FCl_3, amyl alcohol, Bismarck Brown, etc

PARIS

Academy of Sciences, Mar 4 —**A Deslandres** Simple relations between the most intense and highest radiations of the chemical elements in the photosphere of the sun In previous communications it was shown that the frequencies of the highest and most brilliant lines of the sun were multiples of a constant d_1, 1062 5 Additional data showing the importance of this constant are given —**Charles Moureu, Charles Dufraisse, and Léon Enderlin** Researches on rubrene The action of acids The liberation of iodine from hydriodic acid by rubrene, with decolorisation of the hydrocarbon, has been studied in detail Except possibly in ether solution, there is no evidence of any hydrogenation the colourless hydrocarbon produced appears to be isomeric with rubrene —**J Favard** Problems of extremums relative to convex curves —**Maurice Janet** The ratio of the mean values of the squares of two differentials of consecutive order —**Mandelbrojt** How several theorems of Taylor's series can be transformed into Dirichlet's series —**J Delsarte** Symmetroid nuclei —**L Ahlfors** The number of asymptotic values for an integral function of finite order —**M Lavrentieff** A problem of P Montel —**Gr C Moisil** Functional groups —D

Rosenthal Assemblages connected by lateral bands tested in extension and in compression —**Maria Bossolasco** Tho ellipticity of the terrestrial equator —**Foch** The maintenance of the vibrations of a fluid column by change in the regime of flow From Reynolds's definition of the critical velocity an equation is derived which has been applied to the cases of vibrating flames, the chemical harmonicon, and notes emitted by certain hot water systems —**T Pecsalski and J Chichocki** The thermionic emission of copper tubes filled with salts —**J Peltier** The magnetic testing of the shafts of machines —**R Coustal and F Prevet** A new method of preparing phosphorescent zinc sulphide Zinc (in impalpable powder) and sulphur are heated together, with or without the addition of foreign substances The reaction is explosive and must be controlled by reducing the proportion of zinc —**R de Mallemann** The theory of optical activity in a homogeneous medium —**René Delaplace** Some chemical phenomena connected with the contraction of hydrogen in discharge tubes Discharges through tubes of Pyrex glass, not fitted with taps or ground glass connexions, produce measurable amounts of carbon monoxide and methene These may be attributed to the dissociation of the glass under the influence of radiations omitted by the tube —**Raymond Delaby and Pierre Dubois** The preparation of allyl alcohol The method described permits of a yield of 435 grams of allyl alcohol per kilogram of glycerol —**Mlles Jeanne Lévy and Frajda Gombinska** The dehydration of some symmetrically substituted α glycols and the isomerisation of the corresponding ethylene oxides The influence of the relative affinitary capacities of the cyclic and acyclic radicals —**A Seyewetz and J Blanc** The fluorescence of colouring matters in Wood's light The principal dyes of each class have been submitted to Wood's light in powder, in solution, and on fibres, in order to see whether they would present any fluorescence sufficiently characteristic for use in analysis Preliminary results are given —**Assar Hadding and René van Rubel** The structure of the crystalline uraninite of Katanga (Belgian Congo) The X ray method of P Debye has been applied to Katanga uraninite Its crystalline network is that of a face centred tube —**P Fallot** The date of the latest orogenic phenomena in the sub Betic and Betic zones at the height of Caravaca —**Jean Lacoste** The extension of the Cretaceous in the southern region of the western Rif —**Edouard Roch** New observations on the Stephanian of western Morocco —**Ch Maurain and E Salles** Atmospheric ionisation —**Albert Nodon** Researches on electromagnetic perturbations, seismic and solar The results obtained at the Santiago Observatory (Chile) confirm work previously published by the author, and show that close relations exist between electromagnetic, seismic, telluric, atmospheric, and solar phenomena It is possible from the indications of the magnetograph to predict earthquakes some hours in advance —**C I Popesco** The influence of grafting on the development of some Papilionaceæ —**Mme L Randoin and Mlle A Michaux** The comparative variations of the proportion of water in the blood and of the globular resistance in the normal guinea pig and in the guinea pig submitted to a regime deprived of the antiscorbutic vitamin —**Mme M L Verrier** The biology and peculiarities of the respiratory apparatus of an isopod from the Sahara, *Hemilepistus Reaumuri* —**J Magrou, Mme M Magrou, and Mlle F Choucroun** The action at a distance of *Bacterium tumefaciens* on the development of the egg of the sea urchin New experiments —**E Roubaud** Autogenous cycle of waiting and hidden active winter generations in the common mosquito *Culex pipiens* can have two different biological methods of adaptation to the winter In one, well known, the females hibernate at low temperatures, in the other, described in the present communication, both sexes survive if the temperature is maintained above 20° C in presence of water Reproduction is continuous during the winter without food being taken —**Marcel Labbé, F Nepveux, and Hejda** The ammonia of human blood in normal and pathological conditions In cases of jaundice, cirrhosis of the liver, and diabetes, the proportion of ammonia in the blood varies very slightly from the normal the amount is increased to a marked extent in pulmonary tuberculosis —**H Bierry** Biochemical researches on the specificity and transformations of the proteids of the blood plasma —**L Hugounenq and E Couture** The photochemical action of sterols of various origins —**A Dorier** *Gordius* as a parasite of myriapods —**A and R Sartory, Marcel and Jacques Meyer** Contribution to the study of tho mycetones A new case of actinomycosis with yellow pustules

ROME

Royal National Academy of the Lincei, Dec 16 —**T Levi-Civitá** Addition to the note on the motion of a body of variable mass —**Gino Fano** Congruences Ω_0 of rational curves, and Cremonian transformations inherent in a linear complex —**A Russo** Nuclear divisions in *Cryptochilum echini* Mps In this organism the processes of nuclear division are dependent on the category of the individuals to which the nuclei belong, since the nuclei of one category (A) divide by mitosis, and those of another (B) by amitosis These two categories being distinguished by different quantities of nuclear substance, with which correspond particular activities of tho whole individual, it appears that the special division of the nucleus is determined by internal factors which regulate the process —**L A Herrera** Further investigations on the imitation of organic forms with albumin Structures obtained by means of egg albumin and closely resembling *Croococcus, Botrydina vulgaris, Desmidium Grevilli, Bulbochæte, Vaucheria,* and *Nitella flexilis,* are illustrated —**U Cassina** The conception of limits A short, elementary account is given of the results of the author's historical and critical investigation into the conceptions expressed by the term 'limit' —**L Fantappié** Functional operators and the calculus of infinite matrices in the theory of quanta (1) —**M Picone** Demonstration of a theorem of analysis, of which use is made in plane physics —**G Supino** Certain limitations valid for derivates of a harmonic function —**L Toscano** Reciprocal matrix equations —**G Vranceanu** Second fundamental quadratic form of an anolonomious variety and its applications —**V Glivenko** The law of high numbers in functional spaces —**A de Mira Fernandes** Isoclinic transports and associated directions —**F Lamberti** A third cardinal equation in the dynamies of material systems —**E Gugino** The extension to continuous motion of the Lagrange Bertrand theorem relating to impulsive motion —**G Silva** The definition of normal gravity —**E Benedetti** Experiments on the amplification and detection of bio electric currents by means of thermionic valves (2) The photographic registration of the curves of the amplified currents Use is made of a ray reflected by a mirror set in motion by an electrodynamic complex similar to those used to move the membranes of 'loud speakers' —**Clara Forti** The action of vapours of ethyl and methyl alcohols, ethyl ether, and chloroform, and of lighting gas on leucocytes isolated from the organism The vapour evolved by minimum quantities (0 1 0 5 c c) of ethyl or methyl alcohol, ether or chloroform suffices to paralyse

the amœboid activity of the leucocytes of toad blood within a few minutes The action of illuminating gas is slow and results first in an increase in the vivacity of movement of the leucocytes, but later to a gradual retardation of the motion, which is completely arrested after exposure to the gas for eight or nine hours These effects may be either transient or permanent, according to the duration of action of the reagent —**G Galatà** Investigations on the circulatory effects of increases in the atrial pressure — **R Margaria** and **E Sapegno** Blood mass, red corpuscles, and hæmoglobin, in acclimatised individuals, in the mountains and on the plain The observations described were made on ten individuals, first, in August 1927 at Col d Olen (altitude 2901 metres), and, secondly, in the autumn and winter of 1927–28 at Turin, the temperatures in both cases being 10° 13° At Col d Olen, increases in the number of red corpuscles and in the hæmoglobin content of the blood were invariably found The extents of these increases varied markedly in different individuals, the mean values being 12 8 per cent for the corpuscles and about 4 per cent for the hæmoglobin There is, therefore, a diminution in the hæmoglobin content of the red corpuscles, which may be the expression of the immission into circulation of young red corpuscles less rich in hæmoglobin—a phenomenon perfectly analogous to that observed after blood letting As regards the mass of the blood, determined by Haldane and Smith's method, the variations found amounted only to about 5 per cent, which corresponds with the limit of error for a single experiment, there is a mean increase of 1 8 per cent, which indicates that there is a slight increase in the mass of the blood following a sojourn of 15 25 days in the mountains, this being possibly due to the improved hygienic conditions —**R Grandori** Embryological studies on polyvoltine races of the mulberry *Bombyx*

VIENNA

Academy of Sciences, Jan 10 **R Holzapfel** Results of radiation and polarisation experiments on the Hochobir in the summer of 1927 at an altitude of 2040 metres —**E Philippi** and **E Galter** The action of ammonia and amines on the esters of unsaturated acids —**E Philippi** Memoranda for the preparation of some aliphatic unsaturated acids and esters —**F Hernler** The three isomeric tolyl 1 dimethyl 3, 5 triazole 1,2,4 and some of their salts — **G Grekowitz** A meningitis producer from the Pasteurella group In three cases of middle ear discharge a germ was isolated, a small coccus like bacterium easily stained with the usual aniline dyes, but not with Gram A faint smell is characteristic of the colonies Gelatine was not liquefied Milk sugar and mannite were neither acidified nor fermented — **F Werner** Scientific results of a journey of exploration to Western Algeria and Morocco Snakes, lizards, and scorpions are recorded —**E Bersa** The culture and nutrition physiology of the genus *Pilobolus* Easily cultivated on horse dung decoction agar Of nitrogen sources leucine and peptone, of carbon sources xylan, gum arabic, galactose, starch do best A wheat straw extract with peptone and agar proved a good culture medium, also Liebig extract agar peptone —**K Menger** On the sum of regular curves —**K Przibram** Coloration of rock salt by radium rays and re crystallisation Apparently rock salt on compression undergoes re crystallisation, the more rapid when pressure is greater After such re crystallisation the blue colour and the capacity of turning blue have vanished —**O Watzl, K Swoboda,** and **R Singer** Report on a botanical and geological expedition in the Caucasus The Caucasian Alpine Society supplied intelligence The Dongusorun glacier pass (3200 metres) was difficult The Chodschal mountain group (3309 metres) was examined Valleys choked with thick primitive forest were difficult to penetrate, the few paths being mostly on slopes above the tree limit Collections were made of Rhododendron and other shrubs and of the very rich fungus flora

Official Publications Received

BRITISH

The Scientific Proceedings of the Royal Dublin Society Vol 19 (N S.) No 18 The Photo Electric Measurement of the Illumination in Buildings By Dr W R G Atkins and Dr H H Poole. Pp 173 186 (Dublin Hodges Figgis and Co London Williams and Norgate, Ltd) 1s

Transactions of the Royal Society of Edinburgh Vol 56 Part 1 No 9 On the Feeding Mechanism of the Syncarid Crustacea By Dr H Graham Cannon and Miss S M Manton Pp 175 189 2s Vol 56 Part 1 No 10 A Human Blastocyst *in situ* By Dr C Witherington Stump Pp 191 202+10 plates 5s (Edinburgh Robert Grant and Son London Williams and Norgate Ltd)

Education in Kent during the Five Years 1923–1928 Pp xl+314 (Maidstone Kent Education Committee)

The Journal of the Institution of Electrical Engineers Edited by P F Rowell Vol 67 No 387 March 1929 Pp 317 436+xxxvi (London E and F N Spon Ltd) 10s 6d

Report of the Medical Research Council for the Year 1927–1928 (Cmd 3279) Pp 16. (London H M Stationery Office) 3s net

Dove Marine Laboratory Cullercoats Northumberland Report for the Year ending June 30th 1928 Edited by Prof Alexander Meek (New Series 17) Pp 60 (Cullercoats) 5s

Department of Scientific and Industrial Research Gas Cylinders Research Committee Ordinary Commercial Cylinders for the Permanent Gases. Summary of Recommendations (revised) Pp iii+7 (London H M Stationery Office) 4d net.

The New Education Fellowship (English Section). Annual Report 1928 Pp 19 (London)

The Federation of Lancashire and Cheshire Museums First Annual Report 1928 adopted at the Annual General Meeting January 30th 1929 Pp 11 (Liverpool)

Annual Report of the Calcutta School of Tropical Medicine Institute of Hygiene and the Carmichael Hospital for Tropical Diseases 1928 Pp 103+3 plates. (Calcutta Bengal Government Press.)

Journal and Proceedings of the Asiatic Society of Bengal New Series Vol 23 1927 No 3 Pp 249 360+plates 6 13 (Calcutta.)

The Education Question and the General Election being the Annual Report of the National Education Association presented to the Annual Meeting on Tuesday January 22nd 1929 Pp 12 (London) 3d

The British Mycological Society Transactions Edited by Carleton Rea and J Ramsbottom Vol 14 Parts 1 and 2 March 11 Pp 178 (Cambridge At the University Press) 15s

The Proceedings of the Physical Society Vol 41 Part 2 No 227 February 15 Pp viii+113 179 (London) 7s net

Department of Scientific and Industrial Research Building Science Abstracts Compiled by the Building Research Station and published in conjunction with the Institute of Builders Vol 2 (New Series) No 1 January Abstracts Nos 1 200 Pp ii+34 (London H M Stationery Office) 9d

Transactions and Proceedings of the Perthshire Society of Natural Science Vol 8 Part 5 1927–28 Pp 93 204+iiix+plates 35-40 (Perth) 3s 6d to Members 2s 6d

Air Ministry Aeronautical Research Committee Reports and Memoranda. No 1189 (Ae 351) Notes on Longitudinal Stability at Stalling in Gliding Flight. By S B Gates. (T 2647) Pp 7+3 plates 6d net No 1191 (Ae 353) Full Scale Tests of a Standard Bristol Fighter Aeroplane fitted with Pilot Planes at the Wing Tips By W G Jennings (T 2668) Pp 5+8 plates 6d net (London H M Stationery Office)

St Andrews Provincial Committee for the Training of Teachers Summer School St Andrews July 8th to July 26th 1929 Pp 20 (St Andrews)

FOREIGN

Transactions of the San Diego Society of Natural History Vol No 14 Discocyclina in California. By Hubert G Schenck Pp 211 240+plates 27 30 Vol 5 No. 15 A new Pocket Gopher and a new Antelope Ground Squirrel from Lower California Mexico By Laurence M Huey Pp 241 244 (San Diego Calif)

Bulletin of the American Museum of Natural History Vol. 58 Art. 5 Functional Adaptations of the Pelvis in Marsupials By Herbert Oliver Elftman Pp 189-232+plates 9-14 (New York City)

Veroffentlichungen des Instituts für Meereskunde an der Universitat Berlin Neue Folge A Geographisch naturwissenschaftliche Reihe Heft 19 Stabile Lagerung ozeanischer Wasserkörper und dazugehörige Stromsysteme Von A. Defant. Pp 33 Heft 20 Schichtung und Tiefenzirkulation des pazifischen Ozeans auf Grund zweier Langsschnitte Von Georg Wüst Pp. 64+4 Tafeln (Berlin E S Mittler und Sohn)

Ministry of Agriculture Egypt. The Agricultural Journal of Egypt New Annual Series, 1924 and 1925 Pp. ii+166 (Cairo Government Publications Office) 5 P T

Annual Report of the Meteorological Observatory of the Government General of Tyôsen for the Year 1926. Pp. v+154 (Zinsen)

R. Osservatorio Astrofisico di Catania. Annuario 1929 Pp iii+31 (Catania.)

Japanese Journal of Engineering Abstracts. Vol. 6. Pp. v+89 (Tokyo National Research Council of Japan)

Proceedings of the American Philosophical Society held at Philadelphia for Promoting Useful Knowledge Vol 67, No 4 1928 Pp. xx+319 384 (Philadelphia, Pa)

Forty first Annual Report of the Bureau of American Ethnology to the Secretary of the Smithsonian Institution 1919–1924 With Accompanying Papers Coiled Basketry in British Columbia and surrounding Region by H K Haeberlin James A. Teit and Helen H Roberts under the direction of Franz Boas Two Prehistoric Villages in Middle Tennessee by William Edward Meyer Pp. ix + 626 + 188 plates (Washington D C Government Printing Office) 2 50 dollars

Smithsonian Institution United States National Museum Bulletin 145 A Revision of the North American Species of Buprestid Beetles belonging to the Genus Agrilus By W S Fisher Pp v + 345 + 11 plates 65 cents Report on the Progress and Condition of the United States National Museum for the Year ended June 30 1928 Pp. ix + 216 25 cents (Washington D C Government Printing Office)

U S Department of the Interior Forty ninth Annual Report of the Director of the Geological Survey to the Secretary of the Interior, 1928 Pp ii + 77 (Washington D C Government Printing Office)

Department of the Interior U S Geological Survey Water Supply Paper 586 Surface Water Supply of the United States 1924 Part 6 Missouri River Basin Pp viii + 343 50 cents Water Supply Paper 588 Surface Water Supply of the United States 1924 Part 8 Western Gulf of Mexico Basins Pp vi + 229 25 cents (Washington D C Government Printing Office)

Cornell University Agricultural Experiment Station Memoir 116 Rural Population of New York 1855 to 1925 By Bruce L Melvin Pp 120 Memoir 117 Chromosome Numbers in Zea Mays L By L F Randolph Pp 44 (Ithaca N Y)

Department of Commerce Bureau of Standards Bureau of Standards Journal of Research Vol 2 No 1 January Fire Resistance of Hollow Load bearing Wall Tile By S H Ingberg and H D Foster Pp 344 + 42 plates (Washington D C Government Printing Office)

Smithsonian Miscellaneous Collections Vol 81 No 7 Recent Archaeological Developments in the Vicinity of El Paso Texas By Frank H H Roberts Jr (Publication 3004) Pp 14 + 5 plates (Washington D C Smithsonian Institution)

National Research Council Organization and Members 1928 1929 Pp 18 (Washington D C National Academy of Sciences)

Reprint and Circular Series of the National Research Council No 85 Report of the Committee on Sedimentation 1927 1928 Pp 88 1 dollar No 86 Doctorates conferred in the Sciences by American Universities 1927 1928 Compiled by Callie Hull and Clarence J West Pp 88 50 cents (Washington D C National Academy of Sciences)

Bulletin of the National Research Council No 65 Bibliography of Bibliographies on Psychology 1900 1927 Compiled by C M Louttit Pp 108 1 50 dollars No 66 Funds available in the United States for the Support and Encouragement of Research in Science and its Technologies Compiled by Callie Hull and Clarence J West Second edition Pp 90 1 dollar (Washington D C National Academy of Sciences)

CATALOGUES.

A Catalogue of Important and Rare Books on Zoology Geology and Palaeontology (No 434) Pp 18 (London Bernard Quaritch Ltd)

Catalogue No 317 Astronomy Chemistry Entomology Fishes General Natural History Geology Mathematics Ornithology Physics Sundials etc Pp 48 (London Dulau and Co Ltd)

Surveying Drawing and Nautical Instruments (Catalogue S M Section) Pp 121 (London J H Steward Ltd)

Diary of Societies

FRIDAY April 12

Royal Society of Arts (Indian Section) at 4 30 —A T Cooper Recent Electrical Developments in India

Royal Astronomical Society, at 5.—L Rosenhead The Annual Variation of Latitude —E A Kreiken On the Dwarf Nature of the Spectroscopic Binaries —H Horrocks The Longitude of the Royal Observatory Cape of Good Hope from Wireless Signals Oct Nov 1926 —S A Mitchell Atlas Stellarum Variabilium Series VII

Malacological Society (at University College) at 6

Society of Chemical Industry (Manchester Section) (Annual General Meeting) (at Engineers Club, Manchester), at 7 —T R Woolaston Suggestions in Steam Raising

Institution of Mechanical Engineers (Informal Meeting) at 7 — F E F Durham Pumping Plant

Royal Photographic Society of Great Britain at 7 —H W Bennett Sulphide Toning

Junior Institution of Engineers at 7 30 —B V Lambert The Collection of Fine Dust arising from Metallurgical and other Processes

Geologists Association (at University College) at 7 30.—E J Wayland The Later Geological History of the Equatorial Lakes in Uganda

Oil and Colour Chemists Association (Manchester Section) (at Milton Hall Manchester) at 7 30 —Annual General Meeting

Institute of Transport (at Y M C A Newcastle upon Tyne), at 7 30

Society of Chemical Industry (Birmingham and Midland Section) (jointly with Chemical Engineering Group) (at Engineers Club Birmingham) —Dr C M Walter The Design and Operation of Gas Heated Furnaces

SATURDAY April 13

Institution of Municipal and County Engineers (Jointly with Yorkshire and North Western Districts) (in College of Technology Manchester), at 2 30 —W J Hadfield The Local Government Bill, with Particular Reference to the Road Clauses

MONDAY, April 15

Society for the Preservation of the Fauna of the Empire (at Zoological Society of London) (Annual General Meeting) at 4 —Earl of Onslow Presidential Address —Exhibition of Lantern Slides of the Kruger National Park, South Africa

Institution of Electrical Engineers (Informal Meeting), at 7 —M G Tweedie and others Discussion on Power Supply and Railway Electrical Signalling

Institution of Electrical Engineers (Mersey and North Wales (Liverpool) Centre) (at Liverpool University) at 7 —Annual General Meeting

Institution of Electrical Engineers (South Midland Centre) (at Birmingham University), at 7 —Hon. Sir Charles A Parsons and J Rosen Direct Generation of Alternating Current at High Voltages.

Royal Society of Arts at 8 —Sir E Denison Ross Nomadic Movements in Asia (Cantor Lectures) (I).

Royal Geographical Society (at Æolian Hall), at 8 30. —Dr V Stefansson Some Problems of Arctic Travel After a Crash

TUESDAY April 16.

Royal Photographic Society of Great Britain (Colour Group) at 7 — F J Tritton Colour Snapshots

Illuminating Engineering Society —Dr J F Crowley The Use of Intermittent Light for Revealing Moving Machinery

WEDNESDAY, April 17

Royal Meteorological Society at 5 —The late W H Dines and L H G Dines Monthly Mean Values of Radiation from Various Parts of the Sky at Benson Oxfordshire —L H G Dines An Analysis of the Changes of Temperature with Height in the Stratosphere over the British Isles —H A Hunt A Basis for Seasonal Forecasting in Australia

Institution of Civil Engineers (Informal Meeting) at 6 —E T Painton Problems involved in the Design of Overhead Transmission Lines

Institute of Metals (Swansea Local Section) (at Thomas Café Swansea) at 7 —Annual General Meeting

Institution of Electrical Engineers (Tees Side Sub Centre) (at Cleveland Technical Institute Middlesbrough) at 7 —Annual General Meeting

Institution of Electrical Engineers (Sheffield Sub Centre) (at Royal Victoria Hotel Sheffield) at 7 30 —F H Rosencrants Practice and Progress in Combustion of Coal as applied to Steam Generation

Royal Society of Arts at 8 —F E Lamplough Vita Glass

Folk Lore Society (at University College) at 8 —Miss Beatrice Blackwood Folk Tales of the Chippewa Indians

Royal Microscopical Society at 8 —Prof F Ghosh Two New Suctoria from Sewer Water —Dr P [illegible] Dr H S D Garven and Dr R H M [illegible] The Microscopic Anatomy of the Vascular System of the Dog's Spleen Dr D S Spence A Method of Finding the Refractive Index of a Drop of Mounting Medium

Society of Glass Technology (Annual General Meeting and Ordinary Meeting) (at Sheffield) —W Butterworth senr The History of Glass Cutting (Lecture)

THURSDAY April 18

Linnean Society of London at 5 —Dr G C Druce The Botany of Cyprus Dr G S Carter and L C Beadle The Fauna of the Swamps of the Paraguayan Chaco in Relation to its Environment II Respiratory Adaptations in the Fishes

Institution of Mining and Metallurgy (at Geological Society) at 5 30

Institution of Electrical Engineers at 6 —R A Chattock The Modern Use of Pulverised Fuel in Power Stations

Royal Aeronautical Society (at Royal Society of Arts) at 6 30 —Col V C Richmond R 101

Institution of Automobile Engineers (Guildford Centre) (at Technical Institute Guildford) at 7 —H W Pitt Central Lubrication of Chassis Bearings

Institution of Electrical Engineers (Irish Centre—Dublin) (at Trinity College Dublin) at 7 45 —J D Ferguson Electric Time Signalling

British Institute of Radiology at 8 30 —R S Paterson The Less Common Diverticula of the Upper Alimentary Tract.—J V Sparks The Difficulties of Comparative Radiography of the Chest

FRIDAY April 19

Physical Society (at Imperial College of Science) at 5 —Presentation of the Guthrie Medal to Dr C E Guillaume —Prof W R Bridgman The Properties of the Elements under High Pressures (Guthrie Lecture)

British Institute of Radiology (Medical) at 5 —Informal Discussion on Bone Diseases (especially Multiple Myeloma).

Institution of Mechanical Engineers at 6 —W Reavell The Standardisation of Keys and Keyways

Institution of Electrical Engineers (London Students Section) (Annual General Meeting). at 6 15 —V E Connor The Manufacturing and Testing of Submarine Cables

Royal Photographic Society of Great Britain at 7 —B Chambers and F W Sharp Carbon and Carbro

Society of Dyers and Colourists (Glasgow Section) (at 7 Gordon Street Glasgow) at 7 15 —Annual General Meeting

Junior Institution of Engineers, at 7 30 —Lt Col J T C Moore Brabazon Early Aviation (Lecture).

Royal Society of Medicine (Electro-Therapeutics Section), at 8 30 — Dr S G Scott Myeloma—Differential Diagnosis —Dr J D White Bone Lesions in Tropical Diseases

Royal Institution of Great Britain, at 9 —Prof Owen T Jones History of the Grand Canyon, Yellowstone National Park

Society of Dyers and Colourists (Manchester Section) (at Manchester) —Annual General Meeting.

SATURDAY, April 20

Institution of Municipal and County Engineers (Southern District) (at Council House, Bristol), at 10 30 a m —H F Proctor Description of the New Power Station, Portishead

North of England Institute of Mining and Mechanical Engineers (Newcastle upon Tyne) at 2 30

Mining Institute of Scotland (at Royal Technical College, Glasgow).— Annual Meeting

SATURDAY, APRIL 20, 1929

CONTENTS

Editorial and Publishing Offices
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Lord Haldane in Science and Education

THE autobiography of Lord Haldane recently published throws a flood of light on several questions of scientific and educational interest Mr Sidney Webb once expressed the view that men of science who had entered the field of politics had not as a rule distinguished themselves in Parliament, a judgment which, with commendable impartiality, he extended to historians and economists This view was challenged at the time Playfair and Lubbock, it was suggested, had rendered valuable services as members of Parliament, and Huxley as a member of the first London School Board Ought we not to regard these instances as exceptions proving the rule ? To the man of science, groping with his taper along the rugged pathway towards truth, the eclectic arts, the rhetorical triumphs—and at times the over weening confidence—of the politicians make no strong appeal

Whatever view may be taken on this question, it will be agreed that politicians who concern themselves with the promotion of science and education are fulfilling a useful rôle in our national economy With increasing specialisation and increasing demands on both public and private funds for the promotion of research, science needs sympathetic interpreters, missionaries—propagandists, if you will—to whose warnings and exhortations the public will listen with due respect Haldane, as a man of outstanding intellect and untiring industry, as a politician who attained the highest offices in the State, as an active participator in the gravest decision which our nation was ever called upon to make, had many of the qualifications for this essential work That he discharged his duty with conviction and disinterestedness, the reader of the autobiography will admit His success was partial, as he himself admits A man is a hero to his autobiographer, one would suppose, but Haldane writes candidly in his final chapter entitled " Looking Backwards " " I have no sense of success on any very large scale in things achieved But I have the sense of having worked and of having found happiness in doing so " That guerdon is not withheld from the humblest of the world's workers " One touch of Nature makes the whole world kin " Haldane's posthumous candour should induce a tolerance which was not shown by the public during his life

Asked by Cecil Rhodes, " What have you done in your life ? " Haldane replied, " I got the London University Bill through the Houses of Parliament ", on which Rhodes remarked, " That seems to be a very curious thing " The reference was to the

Bill of 1898, introduced by the Conservative Government to transform the examining university into a teaching university. Haldane was justified in his proud boast. Politically, the subject was thorny; the supporters of the old system of impartial examinations exercised powerful political influence, and the proposed scheme of re-constitution bore many of the scars of compromise. Unless some politician of strength and honesty of purpose had espoused the cause, we can well believe that the reform would never have been accomplished. The tragedy was that Haldane so soon showed a sort of Red Queen animosity towards his own offspring. We must await the publication of further biographies and autobiographies before this mystery is fully explained.

An interesting chapter in the history of higher education relates to the breaking up of the old Victoria University, the federal university seated at Manchester. In this important development, Haldane took an active part. Birmingham, under the influence of Joseph Chamberlain, had established the first civic university in 1900. Soon afterwards, Liverpool petitioned for a separate university. "Manchester somewhat half-heartedly supported the prayer of Liverpool, but Leeds strongly opposed it, and was backed by a number of persons who were eminent in the field of higher education in those days." The hearing of the petition by a Committee of the Privy Council lasted three days. Haldane was precluded from acting as counsel for Liverpool, as he had been appointed a member of the Privy Council a short time before the hearing; but he was able to plead the cause as a witness. His arguments for civic and educational personality were accepted. The Committee recommended the grant of university charters to Liverpool and Manchester, and the grant of a charter to the University of Leeds followed a year later. Haldane remarks with truth: "It has always seemed to me that the decision of the Government as advised by the Privy Council in 1903 was a step of the first importance in the history of higher education." But, as he says, little notice was taken of the matter at the time by the public or by writers about English education.

The decision gave a deathblow to the federal idea in higher education in its application to our great cities and started the growth to full university stature of institutions such as the Universities of Sheffield (chartered in 1905), Bristol (1909), of which Haldane was the first Chancellor, and Reading (1926). Several university colleges are in the later stages of adolescence, including those at Nottingham, Exeter, Hull, Southampton. No one would now be found to question the wisdom of the policy advocated by Haldane in this matter.

Haldane's work in the promotion of science and technology at South Kensington is well known. The entry in the index under the author's name states summarily—"Founds the Imperial College of Science and Technology." King Edward VII inspired this great development in a spirit of filial piety, and Haldane was brought into close personal touch with his Sovereign. Haldane's original scheme of a 'London Charlottenburg' suffered a sea-change. No doubt he was offered a surfeit of 'expert' advice. Curiously, Haldane's investigations in Germany had impressed him unfavourably with the separation existing there between the universities and the technical colleges, and he tells us he decided to press for the application of a different principle in London. "The new college was to be fashioned so as to be brought as quickly as possible into a re-constituted University of London." There must be some lapse of memory here, for, in the letter which Lord Rosebery as Chancellor of the University of London addressed to the London County Council in 1903 to explain the Charlottenburg scheme—the letter, we may safely presume, was drafted by Haldane—there was no reference to the question of re-constituting the University and this issue did not arise until some years later. Lord Rosebery, indeed, expressed the hope that it might be possible to follow up the Charlottenburg scheme "by taking further steps towards developing the University in such a fashion as to make it worthy to be the University of the metropolis of the Empire"—but the reference here is obviously to other educational rather than to constitutional developments.

Exasperating delays occurred and an unhappy controversy arose as to the relations of the Imperial College with the University, a controversy which has not yet been brought to a final conclusion. It led directly to the appointment of the abortive Royal Commission on University Education in London over which Haldane presided. The autobiography does not indicate that Haldane derived much satisfaction from his attempt to re-constitute the University for a second time. He is singularly reticent on the whole subject. Nevertheless, he lived long enough to see the last stages of a re-constitution of the University which, the friends of the University hope, will remove some of the defects of the earlier compromise; and he must have watched with pleasure the recent purchase of the Blooms-

bury site by the University, aided by the Rockefeller Foundation, a site he had ineffectively recommended so long ago as 1912 for the great Imperial university he wished to see established in London

Was science able to offer any return for all this effort and goodwill? We learn with pleasure from the autobiography that Haldane benefited from a great discovery in a university laboratory He was a sufferer from diabetes and was treated in the first attack by a rigid diet, "the only palliative known in those pre insulin days" Banting's discovery came at a happy moment, for Haldane would not have been able to count on good health without the discovery of insulin He arranged to have an injection in his arm every morning, and this served admirably, he tells us, taking the place of the pan creatic secretion of the 'Islands of Langerhans' Thus was prolonged a life which had rendered great services to the cause of science and had sounded the full gamut of human thought, emotion, and—may we not add, notwithstanding autobiographical dif fidence—success, achievement

T Ll H

A Neglected Genius

The Collected Scientific Papers of John James Waterston Edited, with a Biography, by Dr J S Haldane Pp lxviii + 709 + 5 plates (Edinburgh and London Oliver and Boyd, 1928) 25s net

IN 1892 the late Lord Rayleigh rescued from ob livion in the archives of the Royal Society a remarkable paper by John James Waterston which had been written in 1845 but had failed to obtain the approval of the Society, and had, therefore, not been printed in the *Proceedings* So completely has his work been ignored that it will probably come as a surprise to the majority that his writings (published and hitherto unpublished), which have been col lected and published by Dr J S Haldane, extend to more than seven hundred pages

Lord Rayleigh did ample justice to the 1845 paper on the physics of media that consist of per fectly elastic molecules in a state of motion Con cerning it he wrote "What strikes one most is the marvellous courage with which he attacked ques tions, some of which even now present serious diffi culties Waterston was the first to introduce into the theory the conception that heat and tem perature are to be measured by *vis viva* In the second section the great feature is the statement that in mixed media the mean square molecular velocity is inversely proportional to the specific weight of the molecules The proof which Waterston gave is doubtless not satisfactory, but the same may be said of that advanced by Maxwell fifteen years later" Boyle's law, Charles's law, Avogadro's law, and Graham's law of diffusion were all placed on a dynamical footing in this paper The causes which contributed to it being denied publication in 1845 are difficult to find At the present time it suffers from having been superseded in style and argument by the work of successors When written, it apparently suffered from being in advance of its time Joule's work on the dynamical nature of heat had been in part published, but the theory of conservation of energy was not authoritatively accepted until about six years later Even so late as 1848, Thomson (Lord Kelvin) wrote "The conversion of heat (or caloric) into mechanical effect is probably im possible, certainly undiscovered In actual engines for obtaining mechanical effect through the agency of heat, we must consequently look for the source of power, not on any absorption and conversion, but merely in a transmission of heat"

Who was the man whose scientific insight drew from Lord Rayleigh such high praise? In answer, Dr Haldane prefaces his collection by a short bio graphy His grandfather was founder of an im portant (still existing) firm of manufacturers of seal ing wax and other stationery, his grandmother was a niece of Robert Sandeman, a well known re ligious leader and founder of the body known as Sandemanians—to which Michael Faraday and his blacksmith father belonged—and sister of George Sandeman, who was founder of the well known firm of port wine merchants

Waterston himself went from school to the Uni versity of Edinburgh and studied mathematics and physics under Sir John Leslie, and was medallist of his year in Leslie's class He also attended lectures on anatomy and surgery—probably drawn to these subjects by his father's and his own interest in phrenology His first published paper was written in his student days when he was nineteen years of age (*Phil Mag*, 1831) It was an attempt to explain gravitation on dynamical principles It is interesting, because in it there is the germ of the ideas which he developed afterwards in his more important paper No further publication occurred until 1843, when an anonymous volume appeared entitled "Thoughts on Mental Functions" Here he sought to study metaphysics as a branch of the physiology of the nervous system Dr Haldane remarks "The book is a very acute essay, far ahead of its time The idea which guided him

was that human behaviour can only express itself in material changes which must, in so far as they are intelligible, be dependent on previous material changes "

In the interim Waterston had become a pupil of James Walker, F R S, a leading civil engineer and president of the Institution of Civil Engineers, and was employed in connexion with the rapidly developing railway system of England He contributed to the Institution a paper on a graphical method of estimating the earthwork in embankments and cuttings He felt, however, that his heart was in pure science and he obtained a post in the Hydrographer's Department of the Admiralty under Captain (afterwards Admiral) Beaufort, who encouraged his scientific ambitions, and later obtained for him the post of naval instructor at Bombay to the East India Company Cadets He held the post, except for a brief period, until 1857, when he returned to Edinburgh, where after some changes he ultimately settled down and remained until his death in 1883

Various papers were submitted by Waterston to different societies and not all of them were accepted, this seems to have embittered him His brother wrote of him " He showed a restlessness and dislike at the mention of scientific men, except Faraday, and he used very strong language in respect to some who bulk largely in public estimation " Dr Haldane surmises that his real antagonism did not arise from the non publication of his papers, but that he was critical of the leading physicists of his time, especially in regard to their thermodynamic reasoning The chief support brought forward for this surmise is the mention in his will of an unpublished manuscript, but as this manuscript was never found, it is rather idle to speculate as to what the subject matter of it might have been The reviewer finds it very difficult to follow Dr Haldane's argument in the pages he devotes to this question Quite certainly there is nothing in Waterston's published writings to justify attributing to him the views which his biographer puts forward

It is unnecessary to dwell on this aspect of Waterston's life He succeeded in getting papers published after his return, and there are many interesting questions dealt with by him In 1858 (*Phil Mag*) he describes experiments on capillarity The argument he kept in view is that if the capillarity of a liquid is the exhibition of part of the cohesive force of the superficial stratum of molecules, numerical relations with the latent heat of its vapour ought to be demonstrable The paper needs to be translated into modern language, but it is sound in idea It may be recalled that Dupré later (1886) developed a similar question, and in recent years E T Whittaker has displayed the close parallelism that exists between surface *energy* and the internal latent heat of evaporation Waterston made a large number of experiments to bring out the connexion, and he deduced, for example, $1\ 45 \times 10^8$ as the number of layers of molecules in one inch in the case of liquid alcohol

Again, Waterston describes a number of experiments on the transition (that is, critical) point of liquids in sealed tubes after the manner of Cagniard de la Tour The tubes were filled to different amounts with the same liquid, and he found the densities of the liquid and vapour when the liquid state terminates He found that the cup shape of the upper surface of the liquid, caused by its capillarity, ceased at a temperature considerably under the point of transition and while the densities of liquid and vapour were very different These observations suggest Prof Callendar's recent experiments on steam (*Proc Roy Soc*, Sept 1928), where about six degrees' interval is found between the two temperatures—the meniscus disappearing when the density of the vapour is only 0 6 of that of the liquid Waterston further claims to have observed that between these temperatures the surface became of ' a sugar loaf aspect,' that is, convex upwards He argues from the data that the rate at which the latent heat diminishes with rise in temperature must augment with the temperature, otherwise the critical point would be much higher than it is He observes that Regnault's curve for the latent heat of steam is discontinuous at 100° C, this is now a well recognised fact

Waterston put forward views on chemistry of which Prof McLeod has said that they " shadow forth many of the ideas of modern chemistry which have been adopted since 1845 "

Altogether, from the historical point of view, it is a good thing that Dr Haldane has done in editing these papers Crude they may seem to day in many respects, but " nothing awakes on its hundredth year without both looking (and feeling) queer ", and it is almost a century since Waterston's first paper appeared What he did, he achieved by very simple means, and modern progress has demonstrated that often elaborate means are essential so that his work was really pioneer work We may sum up by again quoting Lord Rayleigh " To say that he was not always successful is only to deny his claim [not made by him self] to rank among the very foremost theorists of all ages "

A Biologist as Ethnologist.

L'Industrie des pêches au Cameroun Par Dr Théodore Monod (Commissariat de la République Française au Cameroun, Mission Monod (1925–1926) Première partie, Généralités) Pp 509 + 25 planches (Paris Société d'Éditions Géographiques, Maritimes et Coloniales, 1928) 90 francs

RENAISSANCE of interest and pride in their colonial possessions are outstanding and most satisfactory features among the French of to day Prior to the War few Frenchmen went abroad, apart from Algeria, as colonists and planters, and, with some brilliant exceptions, the officials sent overseas were men of inferior quality, of whom their political party or their departmental chiefs were anxious to be quit Their salaries were often mere pittances, and their numbers, judged by the British standard, out of all proportion to real requirements , the sum total of their salaries was frequently excessive as compared with the revenue of their particular colony and a distinct impediment to development and progress Bureaucracy strangled enterprise even among their own countrymen, and French colonial administration was a synonym for inefficiency and red tape

To day much of this is changed A superior class of official is in evidence , better class families in France no longer frown upon a colonial life as a career for their more adventurous sons The Colonial Administration at headquarters is correspondingly enlightened and has had the wisdom to obtain the co operation of the scientific staff of the National Museum of Natural History in their efforts to develop colonial resources The outcome has been the establishment of the Laboratoire des Pêches et Productions Coloniales, under the able direction of Prof A Gruvel, nothing quite comparable with this very useful institution exists in Britain, though by one means or another the needs of the British colonies in this respect do get fairly well met through the willing co operation of various scientific and technical institutions

So far as British West African colonies are concerned, no work has been published comparable with the fine monograph by Dr Théodore Monod upon the fishing industry of the Cameroons, of which the first volume has recently appeared. A bulky tome, it gives in great detail a vast mass of information, technical, ethnological, and linguistic, touching the existing fisheries of the various hydrographic regions into which the territory is divided—the coastal, the riverine, and the lacustrine The present volume deals mainly with the technical and economic aspects, the next will contain the systematic reports of specialists upon the scientific collections made during the various tours The investigation carried out by M Monod, the delegate of the Colonial Fishery Laboratory, lasted rather less than one year , the results reflect the greatest credit on his energy , their presentation is on the whole admirable, but suffers, alas ! from the absence of any index or detailed table of contents Comparative references in consequence are made with difficulty, and the trouble is accentuated by lack of sufficient correlation between the text and the numerous illustrative line figures, charts, and diagrams

The facts recorded are probably of even greater value and interest to the ethnologist than to the fishery expert, and the lack of index is a serious handicap when comparing the methods and appliances of the various tribes The extraordinary variety of the fishing devices in daily use and the complexity of several reveal the intellect of certain tribes as much more versatile and adaptative than is generally credited The ingenuity shown is often surprising , perhaps even more remarkable is the parallelism between many of the more specialised of these methods with those in India It is needless to particularise Practically every device from the simplest to the most complex employed on the rivers and lakes of this part of Africa has its counterpart under similar conditions in India M Monod appears not to appreciate this , he envisages the *local* evolution of such a complicated engine as the great balanced dip net (*zemi*) worked from large canoes by the Kotokos, from the triangular hand-net used for dipping out prawns and small fish, a conclusion which does not take account of the presence of the counterparts of this *zemi* on the Ganges Complex devices are seldom evolved separately , through cultural contact they are passed from people to people, and the facts recorded in this volume support the view of the close relationship of certain of the pre-Aryan peoples of India with the Hamites of Arabia and Africa, through whom part of the common material culture has filtered to the Bantus and to a slight extent even to the Sudanese negroes

Such ethnic problems are, however, of academic interest , another aspect of local ethnography has extreme practical importance, and ethnography is inextricably mixed up in the fishery problems of the Cameroons Certain tribes have neither aptitude nor inclination to utilise the fishery

resources of their tribal territories, others are extremely skilful and resourceful in fishing and make the most of their opportunities But prejudice and tribal ties restrict their operations to a definite area, and many stretches of fecund waters are neglected for want of a population interested and adept in fishing Natural indolence is another factor in limiting fishing in many localities to a minimum, there, the people fish only when they feel inclined for a change of occupation No real or professional fishing exists among such people, whose attitude is typified by the remark of a Duala—" This fish work live for kill man, Massa "

The author's conclusions do not encourage the hope of the successful establishment of any extensive fishing enterprise undertaken by Europeans, except perhaps in deep water trawling, about which data are too inadequate to permit of a definite verdict Here, by the way, M Monod has been misinformed in regard to trawling off the Sierra Leone coast (footnote on p 33) in 1912 a steam trawler worked very successfully off this coast, but the enterprise ended in failure through mismanagement and boycott by the market people

The present methods of the indigenous population are usually well adapted to local conditions, and it is rather initiative and application that require to be fostered than the introduction of new appliances Where improvement is most desirable is in the curing of the product As is usual in West Africa, the ordinary cure is a combination of desiccation by artificial and intense heat with concurrent smoking Little was done to investigate the lines on which improvement may be effected, M Monod is a biologist who worked single handed on an inquiry of extremely wide scope, and it is obvious that this industrial phase of the subject should be taken in hand by one who, besides possessing intimate acquaintance with curing methods, has had a scientific education as a bio chemist

JAMES HORNELL

Detection of Poisons

Laboratory Manual for the Detection of Poisons and Powerful Drugs By Prof Dr Wilhelm Autenrieth Authorised translation by Prof William H Warren Sixth American edition from the fifth German edition, completely revised with extensive Additions Pp xxvi + 698 (London J and A Churchill, 1928) 30*s* net

TOXICOLOGY is admittedly one of the most difficult subjects to handle adequately The student is faced with three serious obstacles toxicology requires a considerable period of uninterrupted study, a period which he can seldom afford, the necessary laboratory facilities are not easily found, and finally, after mastering the principles of his art, he is rarely fortunate enough to come across sufficient opportunities of practising them In the East, of course, where from time immemorial the professional poisoner has been rivalled by the gifted amateur, there is no lack of scope for the toxicologist, both in his chemical and also in his forensic capacity

Autenrieth's well known manual, now appearing in English as the sixth American edition, suffers somewhat from the failure of the translator to bring it completely up to date The author gives general methods of handling cases, wisely stressing the impossibility of conducting a toxicological examination on any fixed plan, and rightly indicating that all details connected with the case, such as the medical history—especially a list of all drugs administered—and the results of the post mortem examination, should be given full consideration The method of examination to be adopted depends in many cases upon the toxicologist's experience

The reviewer believes that the book would have been rendered still more useful by including a really comprehensive summary of recent work published in the technical press, with fuller references to that done elsewhere than in Germany The following detailed criticism is offered in support of this belief Under the head of prussic acid poisoning, no mention is made of the delayed form caused by eating cyanogenetic glucosides The symptoms and post mortem appearances are very puzzling until the cause is recognised

Poisoning due to the absorption of nitrobenzene from shoe polishes has been mistaken, clinically, for poisoning by prussic acid, and might be mentioned under the appropriate head Death from drinking formalin may take place in *less* than three hours The reviewer saw one case where a man swallowed one ounce of so-called '40 per cent formalin' and died in about twenty minutes The stomach resembled a tough fibrous mass the size of a cricket ball

It is somewhat surprising that in a book revised by an American so little is mentioned about the toxic effects of methyl alcohol, and that only German references are given Under the head of picric acid, surely some of the information available since the War on this substance and dinitrophenol might have been incorporated

The one-sided nature of the references is illus-

trated by the fact that the Crippen case is not even mentioned under the mydriatic alkaloids group, and the method described in the text of identifying cocaine by the potassium permanganate test is quite useless when really small quantities have to be identified Hankin's modification of the test, published in 1911, is not mentioned, although it is extraordinarily delicate The reviewer has used it for years and cannot speak too highly of it The methods of detecting and estimating arsenic might be condensed with great advantage, and the section on the toxicology of lead would be more valuable if adequate references were given to the enormous literature of the subject Lead tetraethyl is not even mentioned in fact, the section dealing with metallic poisons is very unsatisfactory

The treatment is quite inadequate elsewhere, as illustrated by the section on boric acid as a food preservative, the only reference being to a dissertation published in Munich in 1883 as so much of the valuable work on this subject was done in America, it is quite extraordinary that, in an American translation, no mention is made of Dr Harvey W Wiley In like manner the section on carbon monoxide poisoning might have been written twenty years ago Surely references might have been made to the large amount of recent work

Another example is that of aconitine, the treatment of which is not up to date, the well known test for which, first described by the late Sir Thomas Stevenson, is ascribed to Führer in 1911 ! The comparison of frog heart tracings on a kymograph is not described No mention is made of the identity of yohimbine and quebrachine and the importance of detecting oxydimorphine in certain cases of suspected morphine poisoning is neglected The section on blood stains and the detection of human blood suffers from the same defects, and requires extensive re writing The amazing statement is made that " if the blood stain is perfectly fresh, it may be recognised by observing blood corpuscles with the microscope Human blood may be differentiated from animal blood by comparing blood corpuscles with those of animal blood as to size, only when the corpuscles are still intact " Further on, however, the biological detection of human blood is dealt with, although in a most inadequate manner, no mention being made of Nuttall, or of Dale's anaphylaxis method

The index is poor, and the apparatus described is in most cases archaic The printing is very good, but the binding is not strong enough to withstand the amount of handling such a book would receive as a constant laboratory companion K C B

Our Bookshelf

Allen's Commercial Organic Analysis a Treatise on the Properties, Modes of Analysis, and Proximate Analytical Examination of the Various Organic Chemicals and Products Employed in the Arts, Manufactures, Medicine, etc Vol 6 *Colorimetry, Dyes and Colouring Matters, the Synthetic Dyestuffs, and the Analysis of Colouring Matters* By the Editors and the following Contributors W A Gallup, Hans Edward Fierz David A W Joyce and V E Yarsley Fifth edition, revised and in part rewritten Editors Samuel S Sadtler, Dr Elbert C Lathrop, C Ainsworth Mitchell Pp ix + 658 (London J and A Churchill, 1928) 30*s* net

The seventh volume of this work is considerably different from the corresponding volume in the previous edition Such subjects as tannin natural colouring matters and inks, which were included with synthetic dyestuffs in the old edition have already been dealt with in Vol 5 of the new edition The new book, therefore, is confined practically to an exhaustive study of the preparation, structure, and analysis of synthetic dyestuffs In addition, there is however a small well written section on colorimetry, which might with advantage have been considered in the same volume with other physico chemical determinations

The largest section of the work consists of an article on dyes and colouring matters, in which dyes are classified on chemical lines on the method of Schultz s Farbstofftabellen and of the Colour Index Importance is placed on absorption spectra as the quickest method of identifying a particular compound Synthetic dyestuffs, the next largest section are concerned with the constitution of various dyes by their reduction products The remaining chapters deal briefly with the analysis of colouring matter on the lines of A G Green s ' Analysis of Dyestuffs which the authors use as the main source of reference

The editors have been careful to prevent much overlapping, especially in the closely connected second and third sections, and the work as a whole is well up to the standard of the previous edition There is, however, a slight tendency for it to take the character of a book on special branches of organic chemistry for the specialists, rather than a book of commercial organic analysis of particular value to the analyst The general production of the present volume, both with regard to printing and paper, is excellent, and comparatively few misprints have been noticed J Reilly

Handbuch der biologischen Arbeitsmethoden Herausgegeben von Prof Dr Emil Abderhalden Lieferung 266 Abt 2 *Physikalische Methoden*, Teil 2, Heft 8 *Die Methoden der Erdbebenforschung*. Von Friedrich Errulat. Pp 2151-2262 (Berlin und Wien Urban und Schwarzenberg, 1928) 6 gold marks

The first work in which the modes of investigating a great earthquake were described was Robert Mallet's report in two large volumes on the

Neapolitan earthquake of 1857 (published in 1862) Since then, though methods of studying perceptible earthquakes have been given in various papers, there has been a great want of a more complete treatment of the subject, such as is attempted in this part of Abderhalden's "Handbuch" About two thirds of it is devoted to microseismic methods, to descriptions of the various instruments employed, and to the interpretation of seismograms Two useful diagrams (on pp 2156 57) illustrate the advantage of damping, one showing the similarity of the records of the same earthquake by two damped pendulums (Wiechart and Mainka), the other giving records of the same earthquake by undamped and damped pendulums

The next section, on the investigation of perceptible earthquakes, is slighter than the other The author quotes Sieberg's list of questions, the Sieberg and Mercalli Cancani scales of intensity, and the Sieberg scale of sound intensity The questions seem too numerous for general use, the Sieberg scale of intensity contains too many tests for each degree, leading to the irregular construction of isoseismal lines, while a scale of sound-intensity depends on a very variable instrument—the human ear—and can only be of service when the number of observations is very large In the remaining sections are described very briefly the investigation of submarine earthquakes, of the causes of earthquakes and related subjects (such as periodicity), of the geographical distribution of earthquakes, of microseismic motions, and of the methods of applied seismology If, in parts, the treatment is somewhat scanty, this is a defect that may easily be remedied in a later edition of a very useful work C D

Buried Treasures of Chinese Turkestan an Account of the Activities and Adventures of the second and third German Turfan Expeditions By Prof Albert von Le Coq Translated by Anna Barwell Pp 180 + 52 plates (London George Allen and Unwin, Ltd, 1928) 18s net

PROF A VON LE COQ gives a vivid account of two expeditions to Eastern Turkestan on an archæological mission from the Berlin Ethnological Museum After giving a historical survey, the labours and excitements of the expeditions are narrated, and incidentally there are ethnographical observations and descriptions of archæological remains At one place the expedition arrived too late to save some remarkable Sassanian Hellenistic paintings, and cartloads of Manichæan manuscripts had been thrown into the river by peasants, as paintings of persons are an abomination to Moslems, they are usually destroyed whenever found Another library of priceless manuscripts had been destroyed in the course of time by water Though there were frequent disappointments, various sites offered a rich harvest of frescoes and other objects which can now be seen in Berlin

The narrative is illustrated by beautiful photographs of scenery, people, monasteries, rock temples, and the like, and especially of Hellenistic statuary and wonderful frescoes A reader desiring more detailed information than the somewhat slight amount supplied in this book is referred to the large number of publications which are mentioned in an appendix

The Great Chemists By Dr Eric John Holmyard (The Great Scientists Series) Pp vi + 138 (London Methuen and Co, Ltd, 1928) 3s 6d net

THIS interesting work is essentially a short history of chemistry, written in a very attractive and informative manner Dr Holmyard has shown great skill in weaving the story of the 'Divine Art' about the lives and works of outstanding alchymists, chymists, and chemists, as he follows his pleasant path down the ages from ancient times to the present day Each of the 'great chemists' is chosen as typical of his period, and the names are Jabir, Razi and Ibn Sina, Roger Bacon, Paracelsus, Boyle, Stahl, Priestley, Lavoisier, Dalton, Avogadro, Davy, Liebig, Kekulé, Pasteur, Arrhenius, Mendeléeff, and Ramsay Few readers are likely to cavil at this selection, which manifestly fulfils the author's purpose of imparting a sense of historical continuity to his narrative It is interesting to notice in passing that the list includes five Englishmen and one Scotsman As would be expected, other names are to be found in the text the index refers to more than thirty workers in the cause of chemistry, the most notable absentees which occur to us being the enigmatical Basil Valentine and that potential Lavoisier of the seventeenth century—John Mayow The authoritative chapter on Jabir is to be particularly commended J R

Elements of Optics By Prof Joseph Valasek (General College Physics) Pp xiii + 215 (New York McGraw-Hill Book Co, Inc, London McGraw Hill Publishing Co, Ltd, 1928) 10s net

THIS is an attractive little book on 'light' which would form a good introduction to the subject for those who will not be concerned with technical applications of geometrical optics The sign convention employed by the author would be very confusing in the treatment of any problems but those of thin lenses, and no attempt is made to discuss more complex optical systems on Gaussian lines, except for a short paragraph on thick lenses The discussion of aberrations is limited to brief notes on spherical aberration, chromatic aberration, and astigmatism in their geometrical aspects

Apart from these deficiencies, the chapters on physical optics are well written, and the sections on colour, radiation, double refraction, and the like, bring the older material into co-ordination with modern ideas The mathematics used is confined to elementary algebra and trigonometry

In a book on optics which discusses quanta and spectral series, etc, it is a little surprising that some of the results of the electromagnetic theory should not be used to discuss such topics as reflection Material of this kind should replace the interesting but unnecessary account of 'relativity'

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications*]

Spectrographic Chemical Analysis

METHODS devised for the spectrographic analysis of mineral substances were described and results given by the late Prof Sir W N Hartley and myself in a series of papers published in the period 1897–1901 (*Trans Chem Soc*, 71, 583, 1897, and elsewhere) Those methods, however, do not appear to have been utilised by any other workers except one, the late M A de Gramont

In the simplest method then described, a weighed quantity, up to half a gram, of the powdered mineral (the exact weight depends on the type of spectrograph and the type of mineral) was tightly rolled in one half of an ash less filter paper and the roll burnt in an oxy hydrogen or oxy coal gas flame before the slit of a quartz spectrograph, a quartz lens being used to focus the image of the flame on the slit The elements which may be detected by this method when present in small quantities are All the alkalis, copper, silver, magnesium, calcium, strontium, barium, gallium, indium, thallium, lead, chromium, manganese, iron, cobalt, nickel, palladium, ruthenium, rhodium, phosphorus, bismuth, and iridium Other elements which may be detected when larger quantities are present are Gold, beryllium, zinc, cadmium, boron, aluminium, yttrium, tin, arsenic, antimony, sul phur, selenium, tellurium, etc

The list, however, may be extended by placing the poles of an arc lamp horizontally in the flame, a little higher than the point at which the roll of filter paper is being burnt, and adjusted so that the image of the arc is focused on the slit The delicacy of the test is greatly increased on striking the arc, and, in addition, elements such as titanium, molybdenum, and tungsten, etc, give lines instead of only a continuous spectrum Experiments so far made indicate that this is a promising field for in vestigation

The spectrograph used by me since 1913 is a Size C Hilger quartz spectrograph (purchased with a grant from the Royal Society Government Grant Fund) and it gives very satisfactory results The photographic plates generally used have been Ilford panchromatic coated on thin glass Plates 5 in × 4 in, suitably placed in the holder, cover the region required in most work, namely, from the red to beyond λ2800, that is, when no arc is used The filter papers recom mended are Munktell's Swedish, No 00, diameter 12 5 cm This spectrograph and method have been used, qualitatively and quantitatively, in the analysis of flue dusts containing gallium and in extracting gallium from flue dust It is seldom necessary to take more than 0 1 gm, and smaller quantities usually suffice

The method has also been applied to the analysis of vegetable and animal substances In examining vegetable material, the twig, straw, leaf, or other part is held by forceps and burnt in the flame without introducing any impurity, even in the form of ashless filter paper By taking weighed quantities, usually 0 1-0 25 gm, the quantities of the mineral constituents can be compared, as, for example, in plants grown in different soils, etc, or in plants such as wheat at different stages of growth, or before and after watering with mineral salts Many interesting results have been obtained in this way

As an example it has been established that rubidium is very widely distributed in soils and in the plants grown on them Further, the growing point of cereals is relatively richer in rubidium, as compared with potassium, than the other parts of the plant It is possible that rubidium is more freely absorbed than potassium, as potassium seems to be more freely absorbed than sodium, but it seems more probable that potassium and rubidium pass up in the sap with equal freedom and that the potassium diffuses or transfuses more readily away from the growing point

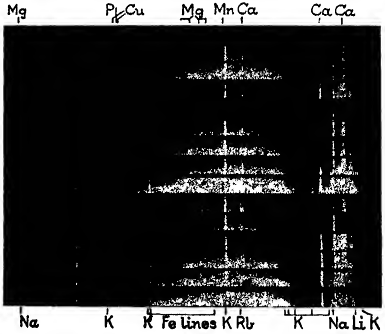

FIG 1 —Stem of wheat grown in soil to which lithium potassium and rubidium salts were added Top four spectra leaves next four sheaths next three grain stem and chaff of ear last four straw sections The first of each set of four was the oldest and the others follow in order of age Cut when the ear was nearly half filled

Animal matter, or soft vegetable substances, may be examined by rolling 0 5 gm in ashless filter paper, but it is better in most cases to dry them in a steam oven and to take 0 05 gm of the powdered dry residue in a smaller piece of filter paper The various organs of an animal may easily be compared for mineral constituents in this way

In some experiments a wheat straw with ear has been divided into eighteen parts grain, leaves, sheaths, and sections of straw, and the eighteen spectra photographed on one plate so that comparison is easy and the record is permanent, the burning occupies twenty to twenty five minutes

During the recent vacation, experiments were made with measured quantities of blood, and it was found that the best results for comparison were obtained by taking 0 1 c c on ashless filter paper Samples of

normal blood and two samples from anæmic patients, kindly supplied by Dr G P Claridge of Norwich, were analysed and distinct differences were noted in the iron, calcium, magnesium, and potassium content Further, the rubidium line λ4202 was present in the spectrum of the normal blood, rubidium, in fact, is present in most parts of the body, and it is present in both human milk and cow's milk

It will be seen that there should be many applications for methods of spectrographic analysis on the lines described above The spectra contain few lines as compared with arc or spark spectra, and the lines are easily identified in practice The methods are worthy of more attention than they have received and they should be especially useful, and possibly prove indispensable, to those interested in the detection and distribution of the metals essential to life, and even of phosphorus, in the parts of plants and animals

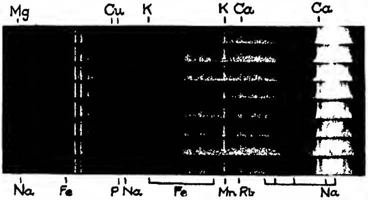

FIG 2 —Parts of body dried at 100° C 0 05 gm of each 1 (top), cartilage epiglottis, 2 spleen, 3, kidney, 4, lung, 5 abdominal muscle, 6 heart muscle 7 brain 8, liver

HUGH RAMAGE

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Evolution through Adaptation

DR BATHER's interesting survey of "Evolution through Adaptation" in NATURE of Mar 30 prompts a few supplementary suggestions There is a tendency in writing upon this subject to think of 'a variation' appearing in the soma under some stimulus which, if maintained for a sufficient number of generations, may produce in the germ a mutation in harmony with the variation in the soma The concept of a mutation of the germ, arising in such a way as to harmonise with an alteration in the soma that has already appeared, is a concept which strains probabilities in many, though not necessarily in all, types of cases Dr Bather's illustration of an animal with defective pigment and sight skulking in dark corners, where alone it is likely to escape its enemies, is used by him to suggest selection of environment by organism, but it is also a reminder to come back to thought of the organism as a whole

Experiment and observation have shown that considerable alterations in the balance of growth can be produced in a population through alteration in environmental influences Such influences operate in Nature generally, we have clear evidences of secular variations of climate through the geological periods, and we know that, in spreading, a form of life encounters modified conditions as its range extends itself

Observation and experiment further show that for various stocks there are 'fringing conditions' under which the individual can indeed live, and even, it may be, grow, but the race cannot reproduce itself, or can do so only very exceptionally The sensitiveness of the reproductive process is a noteworthy fact

If now we set these two points side by side, we may picture a 'marginal case' Let us suppose that the changed conditions of the environment have induced changes of growth, but that the germs remain as before These germs are presumably like all living things in that no two are alike Some variations in them may be towards greater, and some towards lesser, viability in the altered environment It will be from the former that the survivors will be bred We thus think of a process of selection operating on the germs, and operating so as to eliminate, very probably, quite a large proportion of them It is a selection not of a germ that has mutated so as to produce a change in harmony with some change that has appeared in the soma, but a selection of a germ viable in an altered environment The plea here is one which to some extent supplements Dr Bather's suggestions, or, for that matter, Prof Lloyd Morgan's concept of organic selection, for it demands less in the matter of variation of the germ It looks upon variation of the environment of a stock, whether because that stock spreads in space, or lasts through phases of climatic change, as in some sort the initial factor, and it suggests that the extra sensitiveness of the reproductive process, as compared with the other vital processes, is one of the main determinants of the viability of a stock in a fringing zone of distribution It looks upon the germ as basic capital undergoing slow modification, less through the addition of particular mutations corresponding to changes already in the soma than through the selection under marginal conditions of viable variants

These suggestions are in no way in opposition to Dr Bather's, nor does the point of view here developed conflict with that of the advocates of organic selection It merely attempts to supplement them by burrowing under the problem of the inheritance or non inheritance of acquired characters It leaves abundant room for the idea of evolution by germ mutations and so on, and it suggests that growth changes may be essentially physiological responses, some of which may increase, others decrease, viability It leads on to the suggestion that, as cumulative growth changes occur as responses to cumulative environmental change, and are themselves followed, at a long interval, by attunements of the germ which are attunements to environmental changes, the germ in the course of its evolution becomes more and more highly specialised the more and the more recent and the more rapid have been its attunements Thus, if a new series of environmental changes should afterwards supervene, such a highly specialised organism would be less likely to be able to respond than would a less specialised form, a form which had had a longish record of relative evolutionary passivity

H J FLEURE

Aberystwyth

PROF FLEURE is careful to explain that his remarks are not in criticism of anything said by me; yet they seem intended to evade the difficulty that I have found in certain beliefs for which there does appear to be some evidence—the difficulty, namely, of understanding why and how a germinal mutant does appear sometimes to accord with a previous modification of the soma Prof Fleure says this "is a concept which

strains probabilities " Many biologists of no less distinction have regarded the concept as more than probable It is by no means clear that such examples of the transmission of impressed characters as Prof Przibram brought to our notice the other day fall within this concept they seem to be instances of reversible modification Among facts that do support the concept are those genetic analyses of populations adapted to a special environment which have shown that the adaptive characters of some individuals are due to somatic modifications, while those of others are inherent in the germ Cuénot (" L'Adaptation,' 1925) cites in illustration *Centaurea jacea*, forma *humilis*, in the Swedish salt marshes, Gregor and Sansome (*Jour Genetics*, 18, p 349 1927) have traced a similar mixture of mutants and modifications in wild grasses The bearing of these observations on adaptive evolution was discussed in my presidential address to the Geological Society (1928)

In the explanation of adaptation now put forward by Prof Fleure it is not easy to detect anything more than the old Darwinian idea of indefinite continuous variation and selection of such forms as can live in the changed environment Let the environment change ever so greatly, some of the germs will be able to persist and so the line alters from species to species, and from genus to genus (or grade to grade), without any actual change in the germ The original germ has in it the potentiality of all this development If this is what Prof Fleure means, surely he is basing his conclusions on a view long since discarded It is generally agreed now that there are limits to fluctuation, just as there are to individual modification

A palæontologist can produce no evidence for or against such a view he is bound to consider the evidence of workers in other fields, and this, at present, indicates that change (mutation) does affect the germ and that successive mutants, by however little they are distinguished, are actually discontinuous Evolution is by quanta Accepting this, the palæontologist applies it to the phenomena with which he is familiar, and his analysis, if carried far enough, will lead him to those questions to which my Royal Institution discourse attempted to suggest an answer When Prof Fleure writes of attunements of the germ to environmental changes, he merely states in metaphorical language a fact which—if it be a fact—demands an intelligible mechanism

F A BATHER

Spiral Markings on Carborundum Crystals

THE phenomenon described by Prof A W C Menzies and Mr C A Sloat in NATURE for Mar 9, p 348, can, I think, be explained from some results I obtained in 1925 in connexion with the banded crystallisation of sulphur films

The inside of a test tube was covered with a film of molten sulphur by vigorously boiling some of the substance inside The test tube was then lightly plugged with cottonwool and allowed to stand upright After the draining film had cooled almost to room temperature in a few minutes, centres of crystallisation appeared at various points, and rings could be seen growing in succession outwards from the central points The accompanying enlarged photograph (Fig 1) of the test tube shows the result

I found that good rings were obtained in hard glass test tubes, or soft glass which had been cleaned with concentrated sulphuric acid, but that only poorly developed rings could be got in ordinary soft glass test tubes, particularly if alkali was present

I also found that by counting the number of rings from a centre and measuring the distance also from the same centre occupied by these rings and then plotting the logarithm of the number against the logarithm of the distance, an excellent straight line was obtained in every case In one experiment I counted 89 rings or parts of rings in one direction from the centre

The general equation for these straight lines is

$$\log N = a \log r + \log K$$

where N = number of bands, r = distance $\log K$ is the intercept on the axis of $\log N$, and a is the slope of the line to the axis of $\log r$ This gives

$$N = Kr^a$$

as the law of formation of the rings

The explanation of the formation of the rings I had arrived at and considered satisfactory was that the first small crystal formation at the centre caused evolution of latent heat which consequently rendered

FIG 1

the surrounding sulphur more mobile and diminished its surface tension This mobile ring of liquid sulphur was then drawn outwards away from the centre to form a circular ridge which however very quickly crystallised with liberation of more latent heat and formation of another mobile ring and so on That the sulphur is drawn away from the centre by surface tension is clear from the photograph, because the centre is a depression, not an elevation Also the flow can actually be witnessed by means of a lens during crystallisation

It seems that the sulphur has to be in the labile state for these rings to form If it is in the metastable state, then only large crystals grow slowly in the film Some of these can be seen as irregular patches in the photograph

I have measured the rings in the photomicrograph reproduced in Messrs Menzies and Sloat s communication (*loc cit*), both in the direction west of the centre and in that N N W of the centre, and find that the logarithm of number against logarithm of distance give beautifully straight lines In the case of the latter direction (N N W) a is very nearly unity and K 0 417 mm

I would therefore suggest that the spiral formation observed by them has been produced in a similar manner to the sulphur rings described above Further-

more, there appears to be no particular significance in the spiral nature of the markings. It may be noted that Hedges and Henley (*J.C.S.*, October, p. 2725, 1928), in connexion with their work on Liesegang rings, describe spiral formations as anomalies due to accidental external conditions.

William Hughes.

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Southampton.

A Principle of Duality and the Causal Law.

The possibility of a causal space-time description of experience has recently been often denied, and emphasis has been laid upon the purely statistical validity of quantum theoretical relations. This denial of a possible causal space-time description has aroused suspicions and diffidence in regard to the newer physics. The purpose of this note is to show that there is no need for the above denial and that we have not only one possibility of a causal space-time description of experience, but actually two of them. This superabundance of possibilities of description is the very reason, as we shall see presently, why some relations can have only statistical validity.

It is well known that light can be described either as a propagation of spherical electromagnetic waves or as the linear translation of corpuscles of energy and momentum (light quanta); that electrons appear sometimes as point charges and at other times as matter waves; that the atom itself can be pictured, in the case of hydrogen, either as a planetary system of attracting particles (Bohr's theory) or as a system of stationary waves (De Broglie, Schrödinger). Furthermore, it is easy to show, as will be done more fully elsewhere, that the process of emission of light can be described either as the sudden spontaneous ejection of a light corpuscle a finite time (*Verweilzeit*) after the excitation, or as the continuous radiation of a set of spherical damped waves beginning at the very moment of excitation, the inverse of the damping coefficient of which is equal to the extinction time (*Abklingzeit*); that absorption can be interpreted either as the sudden jump of the molecule from one stationary state to another owing to the impact of a light quantum, or as a classical damped resonance of the molecule with the on-coming wave; that optical resonance appears either as sudden absorption with subsequent sudden emission after a time determined by a coefficient of 'spontaneous' transition or as continuous scattering (dispersion), in which the secondary radiation is coherent with the primary (Wood's experiment showing regular reflection of mercury vapour for λ2537). Moreover, Schrödinger (*Ann. d. Phys.*, 82, 257; 1927) has shown that the Compton effect can be described from the point of view of waves as well as of corpuscles, and Heisenberg (*Zs. f. Physik*, 40, 501; 1926) has made clear that both points of view are equivalent in explaining the phenomena of fluctuation. Photo-effect and electron collisions can also be described equally well from either viewpoint.

All of the examples given above show clearly that there are many physical phenomena which can be described in two ways using either one of two essentially different systems of concepts and definitions. The two systems by no means complement each other; *they exclude each other*. Every attempt to superpose the two descriptions in order to reach a unified one leads necessarily to breaks in the laws of conservation of energy and momentum, as has been shown by the many unsuccessful attempts to describe light as energy-momentum centres moving along the Poynting's vector of a wave field (virtual or probability waves).

Now it is easily seen that a space-time description is readily possible using either one of the two systems of concepts and definitions (waves or corpuscles) so long as we keep inside of one of them, and that in this case there is possibility of predicting the future of a physical aggregate which is limited only in the case of a corpuscular description by the principle of indetermination of Heisenberg and Bohr. The classical claim of causality can be maintained in each system. In the corpuscular system we must realise that it is impossible to determine all of the initial conditions of a physical aggregate beyond a certain degree of accuracy. This limitation is unnecessary in a wave description, since the principle of indetermination is superfluous in this case. The classical claim of causality is met here without restriction.

The causal space-time description of the whole of physics remains for the present only a programme, in spite of the dual possibility, owing to the fact that certain phenomena, like interference, can be described satisfactorily as yet from only one point of view. In an all-embracing quantum theory, therefore, it is necessary at present to make use of both systems of concepts at the same time and to jump from one to the other according to the exigencies of the case. At the instant of the jump, every possibility of a space-time description disappears and the magnitudes calculated in one system can have only statistical validity in the other. This is the deeper reason for the purely statistical validity of some relations of quantum mechanics.

The breaks in the space-time description of experience are only a sign of the times, and we may hope in the near future to be enabled to make a causal description of physics in space and time, using a single set of concepts and definitions.

E. Gaviola.

Department of Terrestrial Magnetism,
Carnegie Institution of Washington,
Feb. 11.

Diffraction of X-rays by Two-dimensional Crystal Lattice.

In usual experiments with diffraction of X-rays by crystals, an effect of space lattice is always observed owing to the penetration of the rays into the depth of the crystal. The thin layers, however, in which one

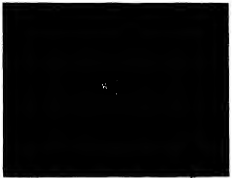


Fig. 1.

could expect the appearance of diffraction by the two-dimensional lattice, scatter the rays too little, and therefore the experiment becomes impossible. The matter is different in a crystal cleft into very thin layers in such a manner that the orientation of separate layers is not destroyed. This may be well

done in mica simply by heating it to red heat and then cooling; but not so well by carefully crushing plates of other crystals. When a thin beam of X rays passes through such a plate, the effect of two dimensional lattices will be added, whereas the space effect will be destroyed by the incoherence of waves produced by scattering from incorrectly spaced layers

On the photograph (Fig 1) obtained by this method with Cu radiation from mica, is seen a system of spectra corresponding to a series of two dimensional lattices making different angles with each other

From the measurement of these spectra the distribution of molecules in the layers of mica may be determined All the spectra obtained may be explained by assuming that the molecules are distributed in the summits of equilateral triangles the sides of which are equal to 5 2 A

The phenomenon is quite analogous to the diffraction of cathode rays from mica obtained by Kikuchi (*Japanese Journal of Physics*, vol v No 2)

Somewhat more diffused photographs by the same method are obtained from gypsum and Iceland spar

A photograph taken of a crystal before cleavage gives the usual Laue figure

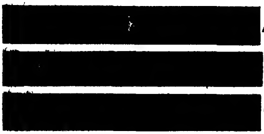
Owing to the facility of interpretation of the spectra of a two dimensional lattice, this method may be of service in the study of crystal structure

W Linnik

Leningrad Optical Institute

High Frequency Discharge in Gases

For some time past we have been studying the problem of high frequency discharge through air and other gases In the course of our investigation we found that whether the electrodes are of external metal sleeves or are of internally sealed aluminium wires, steady striations always appear in the tube under suitable experimental conditions Recently



A
B
C

Fig 1

Heidemann (*Ann d Physik*, **85**, Nr 6, 1928) and Dr S P McCallum and Mr W T Perry (Nature, Jan 12, 1929) have observed striated discharges in hydrogen and argon with external electrodes The general nature of the striated discharges appears to be the same in all gases Over and above what they have noted we have been able to observe certain new characteristic features of the discharges

(1) There is a striking difference in the nature of striations with internal and external electrodes Whereas with external electrodes the striations are generally of the nature of 'double layers' (Heidemann and McCallum and Perry), with the internal electrodes they have always a comb like appearance excepting at very low pressures

(2) As the pressure is lowered the thickness of the striae increases At a still lower pressure the glow extends *beyond* the electrodes and striations can be observed in this region also (Fig 1A)

(3) The same glow discharge can be obtained with only one external electrode In this case the discharge is always of the form of two convergent beams with their apexes away from the electrode (Fig 1B) The beams after converging, however, again begin to diverge from the apexes It will be noticed that there are two very prominent dark spaces in the region beyond the electrode Beginning from this the discharge generally passes into a uniform glow But, with suitable pressure and power regulation the glow can be made to break up into striations (Fig 1C) It will be seen from the photographs that these striations become more prominent as the distance from the electrode increases

Bhabesh Chandra Mukherjee
Atul Krishna Chatterji

Wireless Laboratory,
University College of Science,
Calcutta, Feb 21

Magnetic Behaviour of Organic Crystals

The interesting observations of Sir William Bragg on the deportment of crystals of naphthalene in a magnetic field (Nature, Supplement, May 7, 1927) have been followed up quantitatively in this laboratory, and some very significant results have been obtained. It is found that the diamagnetic anisotropy of naphthalene is extremely pronounced, the susceptibilities along the three magnetic axes of the crystal being approximately in the ratios 16 7 4 That such a high degree of anisotropy is to be expected in aromatic compounds is indicated by the data for magnetic birefringence in liquids, as had indeed been shown earlier (C V Raman and K S Krishnan, *Proc Roy Soc*, A, vol 113, p 511, 1927) Mr S Bhagavantam, who made the measurements, finds that the axes of maximum diamagnetic susceptibility and of minimum optical dielectric constant in naphthalene crystals are approximately coincident This observation explains why organic liquids derived from naphthalene, and indeed also aromatic liquids generally, exhibit a strong *positive* magnetic birefringence We may further expect to find that in aromatic compounds generally, the magnetic and optical characters are linked together more or less in the same way as in naphthalene crystals

The magnetic behaviour of organic crystals of the aliphatic group of compounds is different Not only is the anisotropy, in general, less pronounced, but also the relation between the magnetic and optical characters is more varied In some crystals, for example, iodoform, Mr Bhagavantam finds the axes of maximum magnetic susceptibility and optical dielectric constant are parallel, while in others, for example, urea, they are crossed These facts have a bearing on the explanation of the fact that liquids of the aliphatic class exhibit a magnetic birefringence which is usually much feebler than in aromatic liquids, and further that in some of them the magnetic birefringence is positive and in others negative An extended series of measurements of magnetic birefringence in liquids of the aliphatic class is now being made by Mr Ramanadham here, and is serving to elucidate the relationships between the optical and magnetic characters of organic compounds and their dependence on chemical constitution

Since the position of the magnetic axes of a crystal depends on the orientation of the molecules in the unit cell of the lattice, it is clear that the studies of magnetic behaviour of organic compounds will form a powerful auxiliary to X rays in the analysis of their crystal structure

C V Raman.

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Calcutta, India, Mar 7

Effect of X-rays on Seeds

THE effect of X rays on growth and development is a subject which has always caused considerable interest. It can be studied most easily in plants where cell division takes place so rapidly that daily growth can be observed

We irradiated various kinds of seeds, chiefly broad beans, barley, and mustard, the effects on these forms being dissimilar although the conditions and the dosage were exactly alike It would appear, therefore, that a specific dose is required We used approximately three times the dose of X rays which would cause the human skin to redden, at 120 kilovolts In every case the seeds were covered with black paper to protect them as much as possible from the light and heat from the tube

The broad beans gave the most rapid and striking results Seeds which had been planted for different lengths of time, varying from one week to a few hours, and also dry seeds, were employed, an equal number of seeds in each case being used as controls Stunting followed irradiation in all those which had been growing for more than 24 hours The changes were not observable for some days (two or three) and were first seen in the oldest seeds, but beans which had been growing for 48 to 72 hours appeared to be most sensitive In addition to being stunted the roots appeared to become slightly bulbous at the tip In most cases the shoots appeared later than in the controls, but sometimes failed altogether Side roots never appeared in the stunted X rayed specimens

In mustard seedlings the only detrimental result was the failure of the side roots to develop, and that only in the seeds which had been growing for more than 72 hours before they were irradiated An extremely small dose (about $\frac{1}{10}$ of above) appeared to cause more rapid growth

Little alteration was found in the roots of the barley, as in this plant the shoots were most radio sensitive and showed very much less growth than the controls

RUTH E P PATTEN
SYLVIA B WIGODER

The Department of Zoology,
Trinity College, Dublin,
Mar 11

Local Extinction of a Recently Abundant Lamellibranch

THE Lamellibranch *Spisula subtruncata* (Da Costa) is reported in various old records as occurring abundantly in parts of the Clyde Sea Area For example, in "The Mollusca of the Firth of Clyde," 1878, p 33, A Brown writes "Exceedingly abundant a little above low water in Ettrick and St Ninian's Bays, Bute, and in Fintry Bay, Cumbrae It is common also all along the Ayrshire coast, and in most sandy bays throughout the district In Cumbrae they are known as 'Aikens,' and are used both for food and bait" Further confirmation is found in the *Medusa* records and in the fauna and flora published for the British Association in 1901—records of almost thirty years age and older

By contrast with these records of abundance one of us (R E) cannot recall ever having seen a living *S subtruncata* in the course of twenty years In recent years we have made a very careful search for this species in Cumbrae, Bute, and the Ayrshire coast, etc, without finding a single living specimen, although the shells occur in millions in Kames Bay, St Ninian's Bay, and Hunterston sands

Further, inquiries amongst fishermen reveal the facts that old men (70 80 years) immediately recognise *S subtruncata* as 'Aikens,' and assert that they knew them and used them in youth and middle life, but "have not seen a single full one for thirty years or more" Similar evidence is got from younger men, until we reach men of 45 or so, who say they have never seen or used them although their fathers did

In short, there is good evidence that *S subtruncata* died out in this district about thirty five to forty years ago Type samples of the dead shells have been sent to the Royal Scottish and British Museums and the Fisheries Laboratory at Lowestoft

RICHARD ELMHIRST
A C STEPHEN

Marine Station,
Millport

Successive α-Transformations

IT is well known that, in such parts of the radioactive transformation series as are not disturbed by β emissions, the successive α particles are shot out with ever increasing energy The paradox that, although the probability of emission increases so enormously with the energy, it is the slowest particles that first come out, has once again come to the fore now that wave mechanics has led to a theoretical connexion between energy and decay period It seems worth while to point out that this difficulty can be very simply explained if we assume that all the α particles in question are originally in the same quantum state For if N interacting particles have the total energy NE they will not each fly away with the energy E, it will depend on the nature of the forces acting between them whether the first ones take more than their share or less

A simple example is provided by the helium atom, the removal of one electron involves binding the other closer, and the remaining electron has less energy than it had before the removal If a helium atom is placed in an electrical field it has, according to wave mechanics, an intrinsic probability that it will become ionised (Oppenheimer, *Phys Rev*, **31**, p 66, 1928), and owing to the above energy relation the second ionisation will take place more slowly than the first In the helium atom we have the case that the particles in question, at the distances in question, repel each other, in a radioactive nucleus we have the opposite case For by hypothesis the particles here are so close to one another that their attractions outweigh their repulsions, it follows at once that the first particle is the most difficult to remove

G GAMOW

Institute for Theoretical Physics,
Copenhagen

Astrophysical Estimate of Ionisation Potential of Vanadium

IN a previous letter (NATURE, June 9, 1928) I outlined the method by which estimates of ionisation potentials might be derived from the spectra of Cepheid variables Many of the lines emitted by ionised atoms are intensified at or near maximum luminosity phase and diminish in intensity as the star passes through the phase of minimum light Many arc lines, on the other hand, show the reverse tendency By comparing the behaviour of certain ionised lines with spark lines due to titanium, scandium, strontium, and barium, the ionisation potentials of which are known, it has been possible to estimate this constant for iron, yttrium, and lanthanum (loc cit), and quite recently for vanadium From the periodic changes in intensity of the ionised line λ4205 07 I have obtained for the *ionisation potential of vanadium* 6 74 *volts*, the final figure being extremely uncertain.

In a recent letter from Dr W F Meggers, Bureau of

Standards, Washington, I am reminded that Prof H N Russell (*Ap J*, 66, 1927) has obtained the principal ionisation potential of vanadium from spectral séries relations to be 6 76 volts I am un aware of any laboratory determination of this quantity, but the close agreement between the spectroscopic and the present astrophysical determination is very satisfactory

As before, I am under obligations to the Director of the Dominion Observatory, Ottawa, for the loan of the spectrograms from which my microphotometer graphs have been made A VIBERT DOUGLAS

McGill University,
Montreal, Feb 28

Raman Effect and Fluorescence

SIMPLE probability considerations reveal an interest ing relation between fluorescence and the modified scattering of light If N_r, N_s, etc , be the number of systems in the energy levels of energy values E_r, E_s, etc , the induced probability of transition $E_s \longrightarrow E_r$ may be denoted by W_{sr} If $E_s > E_r$ this causes the emission of a quantum $h\nu_{sr} = E_s \; E_r$, which fuses into an external quantum $h\nu$, so as to form a new quantum $h(\nu + \nu_{sr})$, giving rise to negative or anti Stokes lines The total energy so radiated is $N_s \; W_{sr} \; h(\nu + \nu_{sr})$

Similarly the transition $E_r \longrightarrow E_s$ gives rise to the positive lines of frequency $\nu - \nu_{sr}$, and its total energy is $N_r \; W_{rs} \; h(\nu \; \nu_{sr})$ As a result, the s^{th} level acquires a surplus number $(N_r - N_s)W_{rs}$ systems $(W_{rs} = W_{sr})$ We postulate that thermal agitation restores the normal distribution so that this surplus number reverts to the r^{th} level, emitting total energy $(N_r \; N_s)W_{rs} \; h\nu_{rs}$ of frequency ν_{rs} We identify this radiation with fluorescence Of course it is in the infra red, when the modified lines are visible When ν_{rs} nearly equals ν, it will be shown with the help of Born s formulæ, in a paper appearing elsewhere, that the factor W_{rs}, since it involves a term $k/(\nu^2 \; \nu_{rs}^2)$, becomes very large so that the intensity of a fluores cent line (now visible) is much greater than a modified visible line, as is actually the case

PAUCHANON DAS

72 Srigopal Mallick Lane,
Calcutta, India, Feb 28

Indication of Hydroxyl in a Water Vapour Discharge Tube

THE presence of OH in the gas coming from a water vapour discharge tube has been demonstrated by photographing the exit tube with a quartz spectro graph the well known band at 3060 A was obtained Addition of a small quantity of oxygen to the water vapour has the effect of increasing the intensity of the bands, a larger amount of oxygen causes the appearance of the green oxygen afterglow This glow is continuous in the visible and is accompanied by the OH bands in the ultra violet The active gas appears to possess both reducing and oxidising proper ties This is illustrated by the simultaneous reduction of copper sulphate to copper oxide and metallic copper and the oxidation of metallic silver In both instances heat effects have been observed The glow appears to be unaffected by the copper sulphate, but is removed by the silver An extensive study of the conditions determining the production of OH, its separation from any other active constituents which may be present, and its chemical properties are now under way in this laboratory

G I LAVIN
FRANCIS B STEWART

Princeton, New Jersey, Mar 15

The Green Flash

HERE at 700 feet above the sea the green flash at sunset may be seen whenever the horizon is clear of clouds At times the air is so clear that the moun tains of St Vincent, 110 miles to the west, can be clearly seen at about the time of sunset On such evenings Venus may be followed right down to the sea horizon when as now, it is near its maximum brightness

A few nights ago I watched the planet setting through a pair of field binoculars About five minutes or so before it set there was a great deal of change of colour from red to peacock green, but it was quite evident that the red colour was on the whole below and the green above showing that the image of Venus was being drawn out into a short spectrum When the planet was very nearly on the horizon the colour changed several times from red to green and vice versa, but just as it disappeared the image was of a distinct peacock green

This observation shows that the explanation of the green ray is physical (refraction) as now generally admitted, and not physiological for the light from Venus was not nearly intense enough to produce an after image C J P CAVE

St Nicholas Abbey,
Barbados, Mar 12

African Pluvial Periods

THE interesting remarks in the News and Views columns of NATURE for Mar 16 with reference to Bushveld man and Mr Leakey's discoveries in Kenya, direct attention once again to the Pluvial periods of Eastern Central Africa I should like to be per mitted to point out that while the theory which finds reason for a genetic connexion between these pluvia tions' and glacial episodes of higher latitudes is sound enough, and although there is evidence to show that in all probability some such connexion existed, the correlation of Kenya pluvials with definite periods of the Pleistocene as recently set forth, is purely hypo thetical There is room for discussion concerning them, and according to my showing which may of course be wrong, the Kenya archæological expedi tion s third pluvial is so to say, an epi pluvial, and is (if anything) Buhl and not Wurm in date and so *mutatis mutandis* with the others The Expedition s ground in the Rift Valley is likely to be full of pit falls, and in my opinion a great deal of work must be done there before one can say with confidence which of certain deposits are pluvial and which are not E J WAYLAND

Beryllium and Helium

IN a letter on the 'Transmutation of the Lighter Elements in Stars (NATURE April 13, p 567), R d E Atkinson and F G Houtermans remark that "the isotope Be^8 is probably unstable (it does not occur on the earth) and will then almost certainly break up into two helium nuclei "

I am reminded of an observation made many years ago It was found (*Proc Roy Soc*, A, vol 80, p 587, 1908) that specimens of the mineral beryl always contained helium without appreciable quantities of radioactive matter to explain its presence

Can it be that this helium has originated from the isotope Be^8? If so, it would indicate that the isotope in question, even if it does not exist now, *has* existed within geological times, and subsequent to the forma tion of the mineral RAYLEIGH

Terling Place, Chelmsford,
April 14

Geological Aspects of the Channel Tunnel Scheme

By John Pringle

THE numerous advantages that will result from the making of a tunnel between England and France have long been recognised, but it may not be generally known that in support of such a scheme legislation dealing with the preliminary procedure passed both the French and British Parliaments so long ago as 1875 Less than five years later a start was actually made and headings were commenced on both sides of the Channel, but the failure of the French Channel Company, followed by an order issued by the British Government to close down the work of the British engineers, brought the project to a standstill Now that the scheme has been revived it is hoped that the undertaking will be pushed through to a successful issue Geologists agree that the excavation of the tunnel is practicable, and no obstacles which will defeat the ingenuity of engineers are likely to arise in the course of its construction

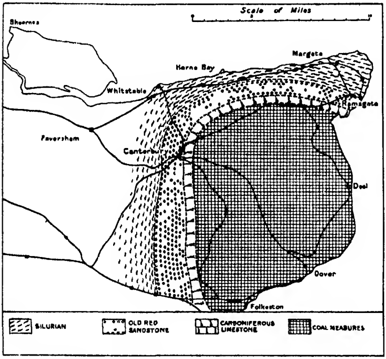

Fig 1 —Sketch map of the Palæozoic strata proved at depths varying from 900 ft to 1400 ft below Ordnance Datum in East Kent

During the years that have elapsed since the heading was stopped at Dover, much has been learned concerning the deep seated geology of East Kent and of the opposite shore of France, and some of the results obtained may not be without interest at the present juncture

It seems scarcely necessary here to relate the views held by early geological observers concerning the physical identity of the coalfields of Somerset with those of the north of France, and the continuity of the higher formations in both countries, nor does it seem needful to do more than merely mention that the theories advanced in 1855 by Godwin Austen, in a remarkable paper "On the Possible Extension of the Coal Measures beneath the South Eastern part of England," gave rise to considerable interest in the problems connected with deep seated geological structures It is sufficient to say that most geologists were so certain of the occurrence of Coal Measures under Kent that Prestwich in 1873 maintained that these old rocks would be found sufficiently near the surface at Dover to allow submarine tunnelling Picturesque accounts of the excavations of a tunnel by working the coal made their way into the columns of the newspapers When the boring made alongside the Channel Tunnel shaft at Shakespeare Cliff proved the presence of Upper Carboniferous Rocks with seams of coal, a great impetus was given to further exploration by the boring tool, and since 1886 more than forty borings and shafts have been carried down to the Palæozoic rocks in East Kent

The information obtained by many of the companies carrying out these explorations was, however, jealously guarded for commercial reasons, and had it not been necessary to seek the advice of geologists, perhaps few details of the borings would have become public knowledge Fortunately, the advice of the officials of the Geological Survey was sought, and they were permitted to examine the cores of nearly all the boreholes The excellent use made of these opportunities resulted, when publication was allowed, in contributions to geological science of the highest value These borings have demonstrated that Kent, instead of being an area of simple geological structure, as was thought, is one of considerable complexity, and more geological formations have been proved underground in that county than in any other in England

As an outcome of the work of the Geological Survey, it is now possible to map the Palæozoic platform, and to show the area occupied by the Silurian, Old Red Sandstone, and Carboniferous rocks (Fig 1) Further, a plan can also be made of the disposition of the Jurassic rocks on the Palæozoic floor and the general arrangement they would present, if all the strata down to the base of the Wealden were removed (Fig 2) Fig 2 is based on that published by the Geological Survey, but certain modifications of the outcrops of the

formations have been made by me to incorporate later information All of these formations are buried beneath a great thickness of Cretaceous and Tertiary deposits, some of which are depicted on Fig 3, and the great anticline of the Weald has been shown to be a purely superficial structure superimposed on an underlying syncline

In Northern France borings have also been made since the heading was driven at Sangatte near Blanc Nez Here the Cretaceous rocks are nearly identical with those of Kent, but the Wealden anticline, which is prolonged into France, has been denuded down nearly to the oldest Jurassic strata These occupy the low lying tract known as the Boulonnais, and they are surrounded by chalk hills In places, inside the ring of chalk, Palæozoic rocks are exposed at the surface, and this fact gave rise to the idea that a Channel tunnel might be excavated throughout in the older strata At Dover, however, the discovery of Coal Measures at the depth of 1158 ft below Ordnance Datum showed such a scheme to be impracticable, quite apart from other difficulties arising from the heavily watered Hastings Sands and Inferior Oolite

The most important formations to be considered in the making of this tunnel are the Gault and the Lower Chalk The lithological similarity of these rock groups as exposed in the cliffs of Kent and in the bold headland of Blanc Nez is so close as to make it certain that no important change in mineral characters takes place in the beds immediately underlying the floor of the Channel For example, the thickness of the Lower Chalk remains practically constant in Kent it is 193 ft, at Blanc Nez, 189 ft The work on the Channel Tunnel can thus be carried out with the advantage that identical strata are to be penetrated at each end

The chief and, one might say, the only engineering difficulty likely to be encountered in constructing a tunnel in the Chalk would arise from the presence of water, and regarding the question of the amount and distribution of water in this formation many useful data have been obtained from the borings, shafts, and other works made in Kent and in northern France during the past forty years The knowledge may be summarised as follows in the Upper Chalk there is a great amount of water, in the Middle Chalk and perhaps in the higher part of the Lower Chalk there is a smaller quantity, but in the remaining portion of this lowest subdivision, the Grey Chalk and Chalk Marl of older writers, except in fissures, little or no water is found, in consequence of the increased amount of argillaceous sediment in this part of the series Thus, the lower part of the Lower Chalk, which has generally been considered the most advantageous position in which to drive the tunnel, is favoured by all recent experience as the driest and most homogeneous part of the Chalk for this purpose

At the same time, the relative dryness of the Lower Chalk does not preclude the possibility of meeting water in some quantity in that subdivision The Chalk, like most other formations, has been subjected to pressure and folding, giving rise to faults and fissures These have a west north westerly trend in Kent, and a similar direction has been noted in France They allow the passage of a considerable volume of water, even in the Lower Chalk Thus, for example, a strong spring is given off from a fissure in the Lower Chalk at Lydden Spout, west of Shakespeare Cliff

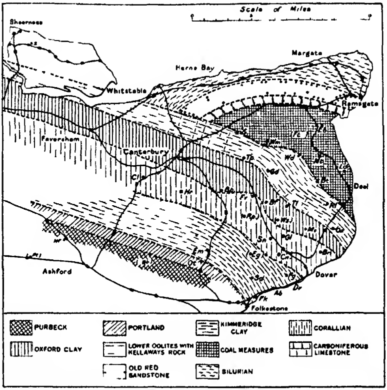

Fig 2 —Sketch map showing the disposition of the Jurassic strata on the Palæozoic floor in East Kent Boring sites shown thus Dv, etc

Obviously, therefore, much will depend on the relation of the tunnel to the trend of the fissures Where the headings run parallel with the fissures little or no water need be expected This was clearly demonstrated by the experience gained in driving the headings at Dover and at Sangatte on the French side of the Channel At Dover a heading 7 ft in diameter was driven for a distance of more than 2000 yards, in a direction approxi-

mately parallel to the lines of faults and fissures A small amount of sea water made its way into the workings, but a hand pump was found sufficient for dealing with the flow, the water caused no inconvenience, and was easily kept out by a ring of tubing After an interval of nearly thirty years the heading was reported to be dry in 1912 On the French side, however, the engineers experienced much trouble in dealing with the water coming from a fault in the lower part of the shaft, and in a length of the heading driven nearly at right angles to the fissures a fair amount of water was also tapped

The excavation of the lower part of the Lower Chalk is therefore not likely to be entirely free from water troubles The difficulties, in fact, may be increased if the original plans for the drainage of the tunnel are carried out It may be remembered that it was proposed to drive a heading with an inclination of 1 in 80 down hill from the shore at each side for a distance of two miles, and then to continue the excavations with a rising gradient of about 1 in 2000 to the centre of the Channel This would probably mean, that part of the tunnel situated under the sea would lie within the Middle Chalk, and would, therefore, cross the fissures at a rather low angle in strata known to allow the passage of water in increased quantities This difficulty might perhaps be overcome by driving the tunnel at each end into a lower geological formation, namely, the Gault Clay This is a point worthy of serious consideration by the engineers If this plan were followed, the highest point at the centre of the tunnel would probably lie within the drier Lower Chalk

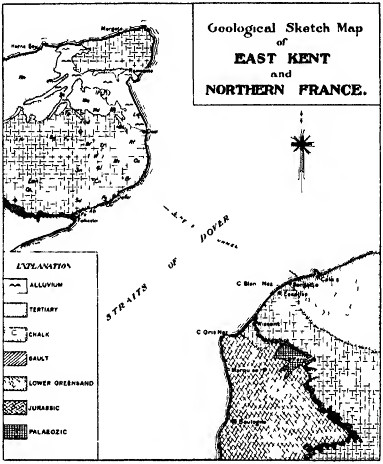

FIG 3

It is probable that in earlier discussions the Gault formation was given less consideration in the belief that it was overlain by water-bearing Upper Greensand, in fact the majority of existing plans show a narrow stippled band between the Gault and the Lower Chalk to represent a supposed outcrop of Upper Greensand Now it has been clearly shown as a result of palæontological investigation that the clay beds IX to XIII of later classifications of the Gault at Folkestone, and their equivalents at the south end of Blanc Nez, represent in argillaceous facies the sandy beds of the Upper Greensand of the west of England Consequently, if the headings at Dover and Blanc Nez were to be driven in the Gault at about the horizon of Bed IX, the workings would lie in argillaceous beds, and the risk of meeting a considerable volume of water would in this way be greatly reduced

As a final remark, it may be suggested that precautionary measures should be taken by the engineers against the possibility of meeting drift-infilled valleys in the Chalk underneath the Straits of Dover The geological chart showing the outcrops of the subdivisions of the Cretaceous rocks on the floor of the Channel, which was made by MM Potier and A de Lapparent as a result of more than 7000 soundings, certainly does not reveal any trace of former valleys in this region, nor has any recent evidence of their existence been obtained, but the fact that many such infilled valleys in the eastern counties of England have been shown to reach depths of more than 300 feet below Ordnance Datum emphasises the need for caution, since such a valley would probably carry a considerable body of water

Work of the Medical Research Council [1]

The report of the Medical Research Council for the year 1927–28 again indicates the wide range of the researches initiated or helped by the Council As in previous years, the work carried out has been aided by grants from various public bodies, including the Dental Board of the United Kingdom, the Miners' Welfare Fund, the Empire Marketing Board, the British Empire Cancer Campaign, and the Distemper Research Council of the *Field* newspaper, as well as by private benefactions At the same time the economy and efficiency with which the available funds are expended are greatly increased by the facilities of the university and other laboratories which are placed at the disposal of workers receiving salaries or grants in aid Of the Parliamentary grant of £148,000, 6 per cent only was absorbed by administrative expenses, £52,000 was provided for the National Institute for Medical Research at Hampstead and the associated farm laboratories at Mill Hill, whilst £86,500, with £18,000 from private and public benefactions, was absorbed by research grants in various university and other centres in Great Britain and by the investigations of the Industrial Fatigue Research Board

Sir Archibald Garrod and Prof Dreyer retired by rotation, and their places were filled by Sir John H Parsons and Dr Robert Muir Sir Hugh Anderson died after the close of the year covered by the report, and the vacancy was filled by the appointment of Prof Leathes Dr H H Dale has been appointed director-in chief of the National Institute for Medical Research

Virus Diseases

Work has been continued on the filter passing viruses and their relation to cancer, and on the treatment of this disease Gye has continued his work on the fowl tumour, in part in association with J H Mueller of the Harvard Cancer Commission, both in Great Britain and in the United States The original experiments indicated that the cell free filtrate by which the growth can be transmitted contains a self propagating virus and a chemical factor the virus could be destroyed by chloroform or acriflavine in serum, whilst the chemical factor disappeared on keeping or warming the filtrate Unfortunately, more recent experiments have failed to give consistent results, treatment of the filtrate either destroying both virus and chemical factor, or failing to destroy the former the inconsistency is presumably caused by the difficulty of obtaining filtrates with uniform properties The disappearance of potency in the filtrate on incubation is due to the presence of an oxidising ferment it can be checked by the addition of hydrocyanic acid, cystein, or reduced glutathione Gye has also found that the filter-passing organism of pleuropneumonia of cattle is destroyed by acriflavine and that the antiseptic's action is aided by the addition of serum, which has an inherent destructive action upon the virus

During the past seven years the outlook for the radium treatment of cancer has been quite transformed definite technical methods have now been worked out for almost every region of the body except the stomach It is already possible to say that early cancer of the neck of the womb can be removed by a course of radium treatment as surely as by the knife, and of course with less suffering and risk Radium is also the best means of treating 'inoperable' cancer of the mouth or tongue, and will probably soon replace excision for the early cases, since it removes the growth without mutilation and with less scarring, and gives a good functional result It seems probable that similar advances will be made in the treatment of cancer in other regions of the body Advance in the use of radium will become more rapid as confidence in its efficacy in the treatment of early cases is gained, as the supply of radium is increased and as the realisation that every treatment centre must be a research centre also and vice versa is generally accepted The report states that the time has now arrived when radium treatment must be put within the reach of all whose lives depend upon it, but this requires a greatly increased supply of radium and an increase in the number of skilled operators and beds available

Work has been continued upon cell growth with the view of elucidating further the nature of tumours and the effects of various agents upon them J A Andrews found that growth *in vitro* of both normal embryonic and malignant tissue is associated with an increase in the hydrogen ion concentration of the medium, and that both tissues *in vitro* are acid in relation to normal adult tissue It might be suggested tentatively that the incidence of malignant disease depends upon the presence of an optimum hydrogen ion concentration coinciding with an autolysate resulting from focal cell death, which acts as the growth promoting agent Helen Chambers, in investigations on the effects of tumour products upon tumour growth, has shown that if the tumour is excised three or four days after irradiation with a lethal dose of the X ray *in vivo*, the animal has absorbed something which confers protection, although the blood contains no immunising power for another animal, and a cell free extract of the excised tumour cannot confer immunity It appears that the antigen producing immunity is absorbed in minute quantities over a period of several days, so that its isolation in concentrated solution is difficult

J R Perdrau has studied that form of encephalomyelitis which is occasionally, though very rarely, associated with vaccinia, as in the ordinary vaccination against smallpox This type appears to be quite distinct from encephalitis lethargica (sleepy sickness) and from poliomyelitis (infantile paralysis), but is identical with that associated with certain

[1] Committee of the Privy Council for Medical Research. Report of the Medical Research Council for the year 1927–28. (London H.M. Stationery Office 1929) 3s net.

acute infections such as measles or smallpox, and with results, also rare, found after antirabic inoculations by Pasteur's method Hence the rare post vaccinal encephalitis is not directly due to the vaccinia virus

The work on canine distemper, already referred to in these columns, by P P Laidlaw and G W Dunkin, has reached the stage of practical application, and numbers of dogs have been inoculated against the disease 73 animals from various packs of foxhounds and 300 dogs of other breeds have been inoculated, but only one contracted the disease in a mild form, although most were exposed to infection Of 170 uninoculated foxhounds which caught the disease, 74 died

The investigations on virus diseases have had another application in quite a different direction Yellow fever is now known to be a virus disease Hindle, adapting the methods devised by Laidlaw and his colleagues succeeded in protecting monkeys against the disease, and the method has already been used in stamping out a local epidemic in Brazil Such a result justifies fully the experimental investigations on canine distemper, quite apart from any practical benefits gained for the dog

ARTIFICIAL LIGHT THERAPY

Some carefully controlled experiments on treatment by artificial light have been carried out by Dora Colebrook on school children No beneficial results were observed light had no influence on gain in weight, height or 'spirits' and the incidence of 'colds' was slightly higher among those receiving the treatment The report critically reviews the results of light therapy and concludes that its sole justifications are in the treatment of rickets and chronic infections such as tuberculosis and, by local application in cases of corneal ulcer or lupus, and possibly varicose ulcers Irradiation of the skin produces vitamin D, from the ergosterol present, and increases the bactericidal power in shed blood, but this increased power has not been correlated with any permanent effects of value to the body, and in any case is quickly followed by a decrease, and the bactericidal power may actually fall below the normal level Moreover, exactly similar effects can be produced by other skin irritants such as a mustard plaster In the case of rickets, the administration of vitamin D by mouth has exactly the same effect as irradiation of the skin by ultra violet light, and since the vitamin can now be prepared synthetically by irradiation of ergosterol and administered in highly concentrated solution, there appears no reason to use artificial light to supply what can be given in the food or as a medicament, especially as the method of oral administration is very much cheaper and more generally available

Sunlight therapy in surgical tuberculosis is undoubtedly very beneficial, but this treatment includes exposure to the open air and also to the longer light and heat rays of the sun, and cannot be strictly compared with a treatment indoors from a source of ultra-violet rays It appears urgent that light clinics should carry out carefully controlled trials of the effects of exposure in the treatment of various conditions

The volume of work on the vitamins carried out during the past year will be separately reviewed later in these columns

TUBERCULIN TEST

The method of detecting tuberculosis in cattle has been improved The 'subcutaneous' tuberculin test has been found to be inconvenient, often fallacious and always difficult to interpret The 'double intradermal' test is simple and convenient, trustworthy and unambiguous, and has now been generally adopted As a by product of this work, G W Dunkin has devised a diagnostic agent for Johne's disease of cattle, a slow wasting disease leading to emaciation, loss of milk, and finally death There is no known cure and no effective means of control except early detection and removal of infected animals The test can be made concurrently with the tuberculin test and has revealed the great prevalence of the disease among stocks in Great Britain its chief danger is in the diminution of the milk supply which results from infection By early diagnosis infected animals can be removed and fattened for killing, and herds kept free from the disease The Council points out that, apart from its indirect hygienic value, this work will save to the agricultural community, in the future, more in a year than has been expended on all forms of medical research supported by the Council during all the years of its work from the beginning

EPIDEMIOLOGY

In investigations on experimental epidemiology carried out on a mouse population kept under continuous observation for eight years, W W C Topley and M Greenwood have found that in each epidemic period the expectation of life of the survivors has been more closely correlated with the length of previous exposure to risk than with the severity of that risk as judged by the average death-rate This suggests that the active immunisation from non fatal infection is a more important factor in increasing the average resistance of survivors than the elimination, by death, of susceptible animals It has also been found that pasteurellosis, an infection primarily of the respiratory tract, and mouse typhoid, a typical intestinal infection, show a definite difference in their epidemiological behaviours, which may be of great significance

L Hill and his colleagues have found that spraying hypochlorite solution into the air of a room or circulating the air through oiled baffleplate filters definitely diminishes the number of microbes present the experiments provide justification for the use of sprays in crowded public rooms

H Burt White has found that there is a close correlation between a positive Dick test and subsequent puerperal sepsis in pregnant women The test is used to indicate susceptibility to scarlet fever, but also indicates susceptibility to the toxins of other strains of streptococci, including those from puerperal fever Arrangements have been made

to carry out an extensive trial of the results of rendering Dick positive subjects immune to puerperal fever before labour

Biological Standards

In concluding this review of some of the important subjects dealt with in this report, reference may be made to the work on biological standards, which has an international importance The first British standard tuberculin has been adopted as the international standard by the Permanent International Standards Commission of the League of Nations Health Organisation its strength is equivalent to that of the standard originally created by Ehrlich The adoption of an international standard of dried scarlatina antitoxin necessitated the production of an equivalent British standard but the method of measuring the potency of an antitoxic serum by its neutralising action on the toxin, as tested by the human skin reaction, cannot discriminate between antitoxins differing from each other by less than 100 per cent Recently, Hartley has succeeded in concentrating the toxin so that its lethal dose for the rabbit can be accurately measured and an adequate number of lethal doses used in the neutralisation test A British standard digitalis powder is in course of preparation and will be made to conform with the international standard already in existence An international physical unit of X ray dosage has also been defined and adopted and agreement reached on the principles governing its standardisation the connexion between physical dosage and biological effect is still being studied

Obituary

Dr T B Osborne

THOMAS BURR OSBORNE, who died on Jan 29, was the last of the small band of pioneers who laid the foundation stones of modern protein chemistry Born in New Haven Connecticut, on Aug 5, 1859, of old New England stock, he graduated after the usual course in arts at Yale College in 1881 Turning his attention to analytical chemistry, he took the degree of Ph D in 1885, and a year later joined the staff of the Connecticut Agricultural Experiment Station in New Haven Prof Samuel W Johnson, director of the Station and professor of agricultural chemistry at Yale, suggested that Osborne should extend Ritthausen's early work on vegetable proteins, and in 1888 he started investigations which continued without interruption until his retirement in 1928

From 1890 until 1901 Osborne's chief interest was in the preparation of pure specimens of the seed proteins, and his initial investigation of the oat kernel, published in 1891, was the forerunner of a series of papers in which the proteins of thirty two different seeds were described These researches demonstrated that proteins could be regarded as definite chemical individuals and that many substances formerly grouped together under such terms as 'legumin,' conglutin,' and vitellin' differed in chemical composition as well as in physical properties His conception of the protein molecule as a definite chemical entity was strengthened by his work on the acid binding power of edestin, published in 1899, and by later papers in which it was shown that proteins in general could form salts with both acids and bases, and that they were capable of electrolytic dissociation

Working as he did in close contact with agriculture, Osborne early realised the need of a chemical characterisation of proteins which would give some index of nutritive value, but characteristically deferred any such research until he was convinced that he could first obtain proteins in the highest state of purity Taking full advantage of the developments in analysis due to Kossel and Fischer, he commenced in 1906 a series of protein analyses which demonstrated that wide differences existed in the amino acid composition of many proteins of economic importance These analyses were made with Osborne's usual extreme care, and were the basis of his future work on the nutritive value of the proteins, begun in collaboration with Prof Lafayette B Mendel of Yale, in 1909, and continued with the generous support of the Carnegie Institution of Washington until the time of his death

The results of Osborne's protein investigations were summarised in a monograph 'The Vegetable Proteins, which was published in 1909, and extensively revised in 1924 His life was devoted almost entirely to his research, and, unlike most investigations, increasing years and fame brought no increase in administrative responsibility, consequently until the last his working hours were spent in the laboratory, and those who were privileged to work with him and gain his confidence found in him not only a genial friend and stimulating critic, but also a man with an unsurpassed wealth of practical experience in his own particular field of science

Osborne was a member of the National Academy of Sciences, an honorary Sc D of Yale, and an honorary fellow of the London Chemical Society Last year the American Association of Cereal Chemists instituted the periodic award of the Thomas Burr Osborne medal for distinguished research in cereal chemistry, and he was himself the first recipient

We regret to announce the following deaths

Dr Paul Dvorkovitz, a well known petroleum technologist, aged seventy two years

His Highness Sir Bhawani Singh Bahadur, K C S I, Maharaj Rana of Jhalawar, who was well known in scientific circles in Great Britain and was a delegate from India at the two hundred and fiftieth anniversary of the Royal Society, on April 13, aged fifty four years

Prof John MacCunn, emeritus professor of philosophy in the University of Liverpool, on Mar. 24, aged eighty two years

News and Views.

PROF D'ARCY THOMPSON'S presidential address to the Classical Association on April 8 at Cardiff is a welcome reinforcement of the plea so often advanced in these pages for a closer alliance between the humanities and science It is the more welcome because it approaches the subject at an unaccustomed angle and in a fresh spirit of hopefulness and enjoyment Whereas we are always thinking, and have often said, how necessary is some knowledge of history to the man of science and some knowledge of science to the historian and man of letters, and how deplorable is the general lack, Prof Thompson boldly takes the cheerful line "From time immemorial science and the humanities have gone hand in hand Aristotle wrote on poetry and Plato loved astronomy And at the Renaissance all the scholars read Galen and Hippocrates" It was the natural thing, and, though the vast extension and specialisation of knowledge now make it more difficult, it is still the most stimulating and pleasurable way to widen and deepen our intellectual associations It is, of course, all that, on the side of personal culture, and far more on the side of civilised life and social continuity Nothing is more important for the future, if mankind is to rise above the pleasures, the problems, and the whirl of the present, than to go back and find the roots of our thought, the first impressions of the wonder and order of the world, in the works of the earliest thinkers who have expressed them for us Socially and philosophically, this sense of filiation and indebtedness is even more valuable than the idea of solidarity with those now living which is now constantly dinned into our ears by the multitude of international associations, from the League of Nations downwards

IN spite of his cheerful tone, one must sorrowfully admit that Prof D'Arcy Thompson is one of a very small band of persons now alive qualified to act as liaison officers between the two camps of science and humanity Scholar and naturalist, he has written a glossary to the 'Birds' of Aristophanes, of which he spoke at Cardiff with such well merited enthusiasm Prof Arthur Platt was another, approaching the matter with the outlook of the Greek scholar The essay which occurs to us as most in sympathy with Prof D'Arcy Thompson's address, and worth reading after it, is Platt's chapter on "Aspects of Biological and Geological Knowledge in Antiquity" in "Science and Civilization," the sixth volume in the Unity Series Unfortunately, it was not reprinted in Platt's posthumous Nine Essays but it is delightful in style and fits in admirably to the sketch which Prof D'Arcy Thompson gave last week Some day perhaps the Classical Association will form a subsection for the study of classical science.

EVERY year marks a further advance in the steady progress of civil and military aviation In great measure this is due to the fact that, almost alone in the field of applied science, research and practice in this case can run hand in hand While the expenditure on air armaments, however, has been bounding up in other parts of the world, the net expenditure of Great Britain for the fourth year in succession, according to the Air Minister in introducing his estimates for 1929, shows a decrease, this in spite of the ease with which it has been demonstrated how vulnerable England is to attack from the air At the end of the year the strength of the Air Force will have been raised from 75 to 82 squadrons, a figure considerably below that of several other great powers On the civil side, this year will mark a notable stage in the development of imperial air communications A regular air service to India has already begun, the first outward journey being completed within 150 minutes of the scheduled time, and the return journey almost exactly on time It is intended to run a weekly service, doing the journey in from six to seven days Meanwhile steps have already been taken for the inauguration of the other great trunk line service—London to the Cape For some years past, units of the British and South African Air Forces have been making service flights over the routes and collecting data, while particularly during the last twelve months much pioneer work has been done by Sir Alan Cobham, Lady Heath, Lady Bailey, and Captain and Mrs Bentley The result has been to provide experience and information without which the regular flight of 6245 miles from north to south would be quite impracticable Every colony and dominion in South Africa is certain to derive great benefit from this venture North and South Rhodesia, for example, at present three weeks from London, will come within ten days' journey, and the Union Parliament at Cape Town will be within twelve days of Westminster The ultimate success of the scheme depends on the financial aid forthcoming from the other Governments concerned

THIS year's air estimates for Great Britain provide for a number of developments of a technical nature Two aircraft are to be specially constructed to test the relative merits of monoplane and biplane, particularly for civil aviation The all metal plane, which has been the subject of intensive study for some time, is now coming into its own Four years ago the Air Ministry was ordering one metal machine for every nineteen of wood construction To day the orders are seven metal machines for one wood, so swift and complete has been the revolution in the methods of construction during the past four years In introducing his estimates, Sir Samuel Hoare paid a tribute to the brilliant work of the experimental pilots at Farnborough and Martlesham and the special efforts of the Aeronautical Research Committee Not the least significant of his announcements was his statement of a proposed grant to the recently formed National Flying Services Company, a step, it is hoped, that will stimulate the air sense of the nation This grant is dependent on the provision, directly or indirectly, of one hundred new aerodromes and landing grounds There can be no doubt that the next few years will witness an enormous speed up of civil and commercial flying in Great Britain

At the meeting of the Royal Meteorological Society on April 17, Dr J Glasspoole gave some details of the scanty rainfall of the first three months of the year The total precipitation over the British Isles during these months was only half as much as usual and less than that of any similar period in the last sixty years of comparable data, the nearest approach being that of 1891, with 60 per cent of the average amount The drought of 1929 was most intense in Great Britain in four well marked areas, each of which received less than one third of the average These areas included a narrow strip across the Thames Valley from Gloucester to Margate, Central Wales, the English Lake District, and much of the northern half of Scotland The fall at stations in these regions was as follows

	Rainfall (in)	Per Cent of Average
London (Camden Square)	1 5	29
Borrowdale (Seathwaite)	9 7	27
Rhayader (Tyrmynydd)	4 2	25
Alness (Ardross Castle)	2 2	22

At Ardross Castle the period included both the driest January and the driest March of the last sixty years, and the total rainfall was less than that of any other three consecutive months The total for January to March at Gloucester was only 1 27 in, and at Shoeburyness only 1 18 in Less than 2 in was recorded at stations in the Midlands, near Oxford and London, and in the neighbourhood of the Moray Firth There was less than 3 in during the three months over nearly half the total area of England and Wales including central and south eastern districts One of the main features of the weather was the marked weakening of the south west winds and consequent deficiency of rainfall in the mountainous regions Parts of the English Lake District and the Western Highlands of Scotland received 25 in less than usual during this period

Holborn recently acquired an unenviable notoriety in being, on Dec 20 and 21 last, the scene of a series of street explosions and fires which took place on a line beginning at the junction of Kingsway and High Holborn, and proceeding westwards along High Holborn, Broad Street, and High Street to St Giles's Circus With commendable promptitude the Home Secretary on Dec 21 appointed a Commission consisting of Mr R G Hetherington, Lieut Col R A Thomas, and Mr E H Tabor, with Mr A S Hutchinson as secretary, to inquire into the circumstances of the explosions and fires, the Commission, which commenced its investigations on the following day, has now issued its Report (H M Stationery Office, Cmd 3306, 1s 6d net) It is concluded that the explosion occurred in the Post Office tube (an old pneumatic parcels tube now otherwise employed), that it was due to a mixture of coal gas and air, that the gas probably resulted from gradual accumulation, together with an escape sufficient to increase the concentration to the explosion limit, and that the gas became ignited in a manhole through some action (probably the use of a petrol lighter) by a workman

In its investigations concerning the nature of the explosive agent, the Commission examined three theories that the gas was coal gas, petrol vapour, or gas arising from anaerobic fermentation The petrol vapour theory was rejected after elucidation of the facts that no odour of petrol was perceptible and that there was no black smoke or luminous flame The theory that the explosion was due to the presence of fermentation gas was carefully studied Evidence regarding the odour was conflicting, none of the samples of gases collected from the ground after the explosion, however, contained methane and carbon dioxide as the chief constituents, whilst all contained oxygen in quantities which negatived the possibility of anaerobic conditions Moreover examination of the subsoil demonstrated that the conditions were aerobic, and the production of anaerobic gas on the requisite scale would have involved sewage decomposition in unacceptably large quantities Alone, the coal gas theory was consistent with all the facts Recommendations concerning ventilation and gas leakage are made, it being suggested that underground cavities, including manholes, should be either continuously ventilated or filled in, that the use of a continuous gas detector would be desirable, and that the gas company concerned should strengthen its organisation for the detection of leakage

Dr A D Little, president this year of the Society of Chemical Industry, who intends to sail for England on June 15 in order to preside over the annual general meeting at Manchester on July 9, has sent a personal message to American and Canadian members of the Society expressing the hope that many will take advantage of the opportunity of consolidating the friendships so happily begun at the meetings of last year and establishing new ones under peculiarly favourable auspices The Raymond and Whitcomb Co, which is dealing with transport arrangements, points out that June 28 and 29, the last sailing dates which will assure members reaching Manchester in time for the opening meetings, are the heaviest of the entire season, so that early notification of probable requirements is necessary The programme in connexion with the annual general meeting commences on Monday, July 8, and continues until Saturday, July 13, it includes addresses by the president, by Prof Pear, and by Sir Richard Threlfall, visits to works, excursions, the annual dinner, and a number of social gatherings American chemists and chemical engineers who may find it possible to visit Great Britain in connexion with these meetings may be assured of a cordial welcome from their British colleagues, by whom the occasion is being anticipated with much pleasure

In opening a discussion at the Society for the Study of Inebriety on alcohol in therapeutics on April 9, Dr J D Rolleston said that from the earliest times the subject has given rise to acrimonious discussions in the medical profession On the introduction of distilled liquors into medicine in the thirteenth

century, the new remedy was regarded as a panacea and as an elixir of life, as was shown by the terms *aqua vitæ* and *eau de vie*, though the designation of *eau de mort*, used by Voltaire several centuries later, appeared more applicable. The remarkable decline in the therapeutic use of alcohol within the last thirty years is best illustrated by the fall in the alcohol bill in various hospitals, but is also shown by the practice of individual physicians and the small place which alcohol now occupies in modern text books of medicine compared with those of forty years ago, when the writers, still imbued with the medieval doctrine, extolled the therapeutic value of different alcoholic beverages in a great variety of diseases. At the present time in the United States only a minority of practitioners have applied for a licence in those States in which the right to prescribe alcohol is granted. The conditions in which alcohol is still chiefly employed are pneumonia, enteric fever, diphtheria, and other acute infections, diabetes, heart disease, tuberculosis, inoperable cancer, and senility, but it does not appear to be indispensable in any of them. In conclusion, Dr. Rolleston maintained that the factors chiefly responsible for the undeserved esteem which alcohol still enjoys as a therapeutic agent are tradition, rather than scientific evidence, extra-medical influences, and personal considerations.

All cities in the world with populations of more than half a million are being faced with the problem of transporting large numbers of workers daily from one section of the city to another. For London, Captain Swinton and Col. M. O'Gorman are advocating a raised ring road 15 miles in circumference which would pass near the eleven railway termini and Earl's Court. According to an article in the *Westinghouse International* for May, considerable relief for congested traffic can be obtained by using modern electric cars operating in subways or on overhead tracks. Some of the new cars are more than 42 feet long and weigh 15 tons. No other vehicle can haul so many people with equal safety at such a low fare. In America, in one city alone the inauguration of a new electric rapid transit system is calculated to save one hundred thousand passengers one hour daily. Cars are now made to accommodate 104 passengers comfortably, fifty horse power motors being used. Trackless trolley buses are also successfully operated in many cities in the United States. They are of the six wheeled type, weighing about 8 tons, using fifty horse power motors and taking their power from an overhead 600 volt trolley wire. A large number of petrol buses are now being supplied with electric equipment which usually consists of a generator and one or two motors. It is claimed that these petrol electric vehicles have many advantages over those operated purely mechanically. They accelerate much more smoothly, and owing to the absence of gears there is very little noise. These improvements are the result of long continued experimental researches.

The Manson Medal of the Royal Society of Tropical Medicine and Hygiene, awarded triennially, is to be presented this year to Sir Ronald Ross. It was founded in memory of Sir Patrick Manson in 1922, and has been awarded to Sir David Bruce and Senator Ettore Marchiafava. Qualifications for the medal are contributions of outstanding merit to knowledge of tropical medicine and hygiene. The Chalmers Medal, which was founded in 1921 by Mrs. Chalmers in memory of her husband, Dr. Albert J. Chalmers, is awarded every second year to the younger workers in the field of tropical medicine and hygiene, who must be under forty five years of age on June 1 of the year of award. It is to be presented this year to Major J. A. Sinton; previous awards have been to Prof. E. Roubaud, Prof. Warrington Yorke, and Dr. H. Lyndhurst Duke. Though the Manson Medal was founded in memory of Sir Patrick Manson, the Society is endeavouring to found a more substantial memorial in the shape of a permanent home for the Society. To this end the 'Manson House' Fund was started, and already donations have brought in £4373, while £3000 have been promised on loan without interest. It is hoped that a sufficient sum will now soon be raised to enable the Society to purchase suitable premises which will form the headquarters of the Society and will be named after Sir Patrick Manson, the first president of the Society.

The tenth annual meetings of the American Geophysical Union and of its sections will be held in the National Academy and Research Council Building, Washington, D.C., on April 25 and 26. Following the business meeting of the general assembly of the Union on the afternoon of April 26, the Union will hear the five following general interest papers, all relating to current or recent work, presented by the Section of Oceanography: The expedition of the submarine S21 to the Caribbean Sea and Gulf of Mexico, by C. S. Freeman; oceanography and the fisheries, by Henry B. Bigelow; the international ice patrol, with special reference to its economic aspects, by Edward H. Smith; the co-operative survey of the Great Lakes, by Charles J. Fish; the work of the *Carnegie* to date, by W. J. Peters. The six sections, dealing respectively with geodesy, seismology, meteorology, terrestrial magnetism and electricity, oceanography, and volcanology, will hold short business meetings to be followed immediately by progress reports and scientific papers. The scientific sessions will be open to persons interested in geophysics, whether members of the Union or not. These annual meetings are increasingly interesting each year, not only because of the stimulus afforded the study of problems concerned with geophysics, but also by reason of the co-operation of the corresponding geophysical organisations of Canada and Mexico, which is making for initiation and co-ordination of geophysical researches depending upon international and national co-operation.

In the course of his presidential address to the Institution of Professional Civil Servants at the annual general meeting on April 12, Sir Richard Redmayne dealt with the position of the technical expert in the civil service. He referred to the claim which the Institution is putting forward on behalf of scientific

members of the Civil Service, of whom, thanks to the understanding it has recently reached with the Association of Scientific Workers, it is fully representative The claim is not just a demand for 'more money', it is based upon the thesis that a modern State must accord to the scientific worker a status and a sphere of influence as high and as extensive as are enjoyed by those whose duty it is to take what is usually known as 'the decision' The case of the scientific worker is, however, only one aspect of a much larger problem, namely, the status of the technical expert in public administration The Institution is of opinion that the watertight division between 'administrators and technical advisers' is leading to inefficiency and waste owing to the absolute power placed in the hands of the administrator to determine matters of policy in regard to which technical considerations may be paramount At the present time the organisation of the Civil Service is on the basis of the needs of departments of State some two generations ago The reorganisation of the Service in the light of scientific progress is of such vital public importance that it calls for an inquiry by a public body The Institution, the chief aim of which is increased efficiency of the public service, will not rest content until such an inquiry has been made

Sir Hubert Wilkins intends to return to the Antarctic in September to continue his explorations by aeroplane He has given an account of his plans in the *Times* From Deception Island, where his Lockheed machines are now stored for the winter, he and Lieut Eielson will fly south to Hearst Land along the western coast of Graham Land On this long flight no landing place is assured, for the coasts are rugged and the sea will be open, but strewn with ice Sir Hubert suggests that tabular icebergs might afford emergency landing places On the other hand, they may not be available On Hearst Land a depot will be made, and there the aviators will await reports of favourable weather conditions from the whalers and Commander Byrd in the Ross Sea before starting on the flight of 2000 miles to King Edward Land along the unknown coast line of Antarctica This must be a risky flight, for conditions are entirely problematical, but it should be possible to cover the distance between successive blizzards Sir Hubert hopes to locate a suitable site for a meteorological station, and in any event he will, if successful, add a considerable stretch to the coast line of Antarctica

Mr A M Daniel, director of the National Gallery, Dr Cyril Norwood, headmaster of Harrow School, and Mr W J Tapper, president of the Royal Institute of British Architects, have been elected members of the Athenæum under the provisions of Rule II of the Club, which empowers the annual election by the Committee of a certain number of persons of distinguished eminence in science, literature, the arts, or for public service

We are informed that, as a result of a recent meeting, a body has been constituted under the title of the "Ultra Violet and Allied Trades Association," consisting of a number of the leading firms engaged in the design, manufacture, and marketing of ultra violet, physio therapy, and other electro medical apparatus in Great Britain The Secretary of the Association is Mr C Rodgers, and the offices are at Kern House, 36 Kingsway, London, W C 2

The Swedish Government has placed an order with the Marconi Company for the supply of a 60 kilowatt aerial energy transmitter for installation at Stockholm The fact that this contract was obtained by the Marconi Company in the face of keen competition is a tribute to the excellent design and performance of British broadcasting transmitters already installed in more than twenty countries outside Great Britain The new Swedish broadcasting station will be effective over a very large area It will be operated on the low power modulation system with deep and distortionless modulation, and will be worked direct off a three phase public electric power supply

Mr H V Garner and Capt E H Gregory will again be available to demonstrate the Rothamsted and Woburn Experimental Plots during the summer to farmers and other bodies interested in agriculture or market gardening At Rothamsted the soil is heavy The experiments deal with the manuring of arable crops, grazing land, and hay land with crop diseases and pests, and with new methods of laying down of land to grass At Woburn the soil is light The experiments there are concerned more particularly with the manuring of potatoes, sugar beet, wheat, malting barley, and the use of green manures Communications should be addressed to the Secretary, Rothamsted Experimental Station Harpenden

A catalogue (No 167) of second hand books of science, ranging over most branches, has just been published by Messrs Dulau and Co, Ltd, 32 Old Bond Street, W 1 It can be obtained free upon application There are upwards of 1400 items listed and the prices asked appear very reasonable

Applications are invited for the following appointments, on or before the dates mentioned —A general engineering master at the Acton Junior Technical School—J E Smart, Municipal Offices, Acton, W 3 (April 27) An inspector under the Ministry of Agriculture and Fisheries for the purposes of the Diseases of Animals Act, 1894–1925—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S W 1 (April 29) A second assistant in the County Analyst s Laboratory, Derby—The County Analyst, County Offices, St Mary's Gate, Derby (April 29) Two assistants on the higher technical staff of the Victoria and Albert Museum—The Director and Secretary, Victoria and Albert Museum, South Kensington, S W 7 (May 4) A lecturer in civil engineering and building trades work in the engineering department of the Portsmouth Municipal College—The Secretary, Municipal College, Portsmouth (May 4) A lecturer in economics at the City of Birmingham Commercial College, with special qualifications in transport subjects—The Principal, City of Birmingham Commercial

College, Suffolk Street, Birmingham (May 4) A workshop instructor in carpentry and joinery at the Birmingham Central Technical College—The Principal, The Central Technical College, Suffolk Street, Birmingham (May 6) A technical officer for the Air Ministry Technical Development Staff, primarily for work at the Royal Air Force Base, Gosport, in connexion with the development of torpedoes for aircraft use—The Secretary, Air Ministry (S 2) (quoting B 335) (May 11) A research assistant in the department of coal gas and fuel industries of the University of Leeds, for work in connexion with the Joint Research Committee of the Institution of Gas Engineers and the University—The Registrar, The University, Leeds (May 12) A post in the zoological department of the University of Manchester—The Registrar, The University, Manchester (May 14) A professor of physiology in the University of Bristol—The Secretary, The University, Bristol (May 16) An assistant lecturer in physiology in the physiological department of the University of Birmingham—The Secretary, The University, Birmingham (May 31) Probationers for the Indian Forest Service—The Secretary, Services and General Department, India Office, S W 1 (July 1) An assistant in the mechanical engineering section of the Engineering Department of the Halifax Municipal Technical College—The Principal, Municipal Technical College, Halifax A medical woman with experience in teaching anatomy, to act for the professor at the Lady Hardinge Medical College, New Delhi—The College Principal, Lady Hardinge Medical College, New Delhi, India A laboratory steward in the physics department of the Military College of Science, Woolwich A qualified technical chemist at the Stores Inspection Department of the Office of the Crown Agents for the Colonies—The Crown Agents for the Colonies, 4 Millbank, S W (quoting O/Sec Office 91)

Our Astronomical Column

The Radius of Space—The following cablegram (which has been somewhat expanded from its very concise telegraphic wording) was received from Dr Ludwik Silberstein on April 10 "A star formula which is developed in the course of my monograph 'The Size of the Universe,' now in course of publication at the Oxford University Press, when applied to 35 stars of type O yields for the radius of space the value 3 2 × 10^{11} astronomical units, when applied to 29 Cepheids, 3 0 × 10^{11}, and when applied to the 246 more distant stars of Young and Harper's list, 3 4 × 10^{11} units The latter computation was completed on April 7, its agreement with the two former ones definitely establishes that space is finite, and that its radius is thirty trillion miles (in the British use of the term), or about five million light years"

The Einstein theory has familiarised us with the idea of space being limited and re entrant into itself, the surprising point in the above communication is the much smaller value that is assigned to the radius than has been found by other methods It is, indeed, only a small fraction of the estimates of the distances of the fainter spiral nebulæ that have been assigned in recent years by Profs Hubble and Shapley, these go up to 140 million light years The acceptance of Dr Silberstein's value would mean a drastic revision of the whole method of determining distances by the periods and apparent magnitudes of Cepheid variables, assuming its truth for the moment, we note that the two spirals, the distance of which Hubble found to be about a million light-years (the Andromeda nebula and Messier 33), should also be visible in the opposite direction, since their distance by that route would be only nine times as great as by the shorter route, it so happens that there are conspicuous nebulæ very near the opposite points—*h* 3433 and Messier 83 respectively, their positions for 1860 are respectively R A $12^h\ 44^m\ 37^s$, S Decl 40° 18 7′, and $13^h\ 29^m\ 9^s$, S 29° 9 0′ The appearance of Dr Silberstein's monograph will be awaited with interest, but in the meantime his announcement will necessarily be received with some reserve

The Spectrohelioscope—Prof G E Hale, the inventor of the spectrohelioscope, contributes an article upon it to the *Scientific American* for April, he shows that it is not a mere toy, designed to enable the eye to discern features that could be equally well studied by photography, in fact, in several respects it gives the observer powers of study much greater than those afforded by the photographic plate This only records the aspect at a single instant, whereas the observer with the spectrohelioscope can quickly detect the most active regions of the disc, and follow the changes continuously Prof Hale says "I have frequently seen the swift flow towards sunspots of masses of hydrogen larger than the earth, adequately recorded with the spectroheliograph only once in twenty years"

Prof Hale goes on to describe a further improvement, the 'line shifter', this is an adjustable plate of plane glass behind the second slit, which permits the observer to set different parts of the width of the line on the slit in quick succession, this gives information about the radial motions in different regions of the formation One side of an arch may be seen to be rising, while the other is falling Prof Hale has prepared instructions whereby a handy person can construct a spectrohelioscope at a cost "comparable with that of a fine radio set"

Greenwich Observations of the Sun and Planets—The Astronomer Royal and Mr R T Cullen contribute a paper on this subject to the January number of the *Monthly Notices* of the Royal Astronomical Society The study of the solar observations is carried back to those of Bradley, beginning about 1750 It was found that early observations of the sun in right ascension were subject to large errors, those in declination appeared to be more satisfactory Accordingly, the error in longitude has now been deduced from the observations of declination made near each equinox, this is a similar process to the well known method of Flamsteed for determining the equinox The 'secular acceleration' of the sun is clearly shown by the residuals The coefficient of T^2 is deduced as + 0 78″, which is comparable with that found by Dr Fotheringham The solar residuals show oscillations which accord fairly well in period and phase with those of the moon, but are about one tenth of the amplitude

As regards the outer planets, the residuals of Saturn changed abruptly from + to - at the date of the introduction of the moving wire, 1915 Those of Neptune have been changing fairly uniformly from zero early in the century to - 3″ in 1928 Its latitude also shows progressive change, but not quite so regular

Research Items

A PREGNANCY CUSTOM IN WEST AFRICA.—Dr. J. Maes describes in *Man* for March a recent acquisition of the Musée du Congo Belge from the Katanga which is connected with a child-birth custom distributed through a wide area in West Africa. The object is a clay figurine of a seated female figure holding on her lap a disproportionately large bowl. The stylisation of the hair indicates that the figure represents a woman of the Bena Kanioka. It is the first record of this custom among these people, though figures of this type are common among the Baluba. These figures are made by men during the pregnancy of their wives. When the time of delivery approaches, and the woman is no longer able to work in the fields, the figure is placed at the door of the hut and all passers-by place alms in the bowl. These gifts are shared among the woman's friends when they return at night in return for the produce of their fields which they give the expectant mother, and for labour which they have expended on her garden. This custom is found among the Yoruba, and clay figures made by the peoples of the Gulf of Guinea exhibit exactly the same characters as these from the south of the Belgian Congo.

THE TASMANIAN SKULL.—Prof. Wood Jones (*Jour. Anat.*, vol. 63, pt. 2, pp. 224-232) in a recent paper gives a group of four graphic reproductions of the average or composite skull of the Tasmanian, the first of a series of racial types with which he proposes to deal in turn. The reproductions include the normæ lateralis, facialis, occipitalis, and verticalis, and are based on ninety skulls. The author finds that the whole cranium presents a rounded and well-filled contour which is considerably in advance of that shown in figures usually given in works on physical anthropology. The temporal fossæ are well filled and the vault of the skull evenly rounded in facial view. The forehead is not markedly narrow nor is the vault of the cranium low or long. The cranial capacity, using Lee's formula, averages 1353 c.c., or, using the formula of Broca and Manouvrier, 1424 c.c. This is high compared with the previous estimates of 1220-1230 c.c. The author concludes that the commonly accepted low average cranial capacity in this race, like the reputedly humanly low class features of the cranium, has been wrongly emphasised, with the result that the Tasmanian has been ascribed a lower place in the human scale than the examination of his cranium warrants.

SPAWNING MIGRATION OF SALMON.—A report just received from Russia ("Physico-chemical characteristic of breeding migration fast of Keta Salmon," by Prof. B. P. Pentegoff, U. N. Mentoff, and E. F. Kurnaeff. *Bulletin of the Pacific Scientific Fisheries Research Station*, vol. 2, part 1. Vladivostok, 1928) contains an interesting study of the breeding migration fast of the Keta salmon. It is stated that the total distance traversed by the Amur River autumn salmon during the spawning migration is about 1200 kilometres in the river alone. The information upon the sea portion of the migration is meagre, but on the basis of a single marked fish liberated from the Island of Unda and later recaptured in the River Pankara, Kamchatka, the authors conclude that the sea migration is similar to the river migration, that is to say, in a contranatant direction and towards increased temperature. During this portion of its migration the fish travelled at a rate of 70 kilometres per day for 34½ days, without food. Perhaps the main value of the paper lies in the detailed physical and chemical studies of the fish at all stages of the journey up river, during which the speed of the fish is said to be on the average 115 kilometres per day, and to be in inverse ratio to the speed of the current. A total of 172 fishes (equal numbers males and females) were subjected to minute analysis. From the sea to the time of death after spawning, the males lost 77.21 per cent of their reserves of energy, and females 78.75 per cent. At first the proportion of energy expenditure from the destruction of fat to that from the destruction of protein increases, but this relation is later reversed. It is calculated that the average daily expenditure of energy in their passage up the river is 25,810 small calories for males, and for females, 28,390 small calories, for each kilogram of live weight. Among the more important chemical changes in the muscular tissue are the following. From the sea to the time of death at the spawning ground, the loss of fat was 98.72 and 97.27 per cent in males and females respectively; of proteins, 57.29 and 57.68 per cent; of ash, 47.03 and 47.07 per cent; and of water, 15.18 and 20.74 per cent respectively.

BRYOZOA AND ALGÆ OF MUTSU BAY.—Dr. Yaichiro Okada reports on the cyclostomatous Bryozoa and Mr. Yukio Yamada on the marine Algæ of Mutsu Bay ("Cyclostomatous Bryozoa of Mutsu Bay" and "Marine Algæ of Mutsu Bay and Adjacent Waters, II," *Report* of the Biological Survey of Mutsu Bay, 8 and 9. *Science Reports of the Tôhoku Imperial University*, 4th Series (Biology) Sendai, Japan, vol. 3, No. 4, Fasc. 1, 1928). Both papers are contributions from the Marine Biological Station, Asamushi, Aomori Ken. The Bryozoa in their zoogeographical distribution combine the characteristics of the Pacific boreal sub-region and the Indo-Pacific coastal region. In continuing his work on the marine algæ, Mr. Yamada has himself made extensive collections, adding very appreciably to the knowledge of the flora of the district. Not only does he record and describe many rare forms, but, what is really more important, he also shows that many species are common which were not before known to live there at all. Some of his most interesting finds belong to the Elachistaceæ, growing in pools on fronds of *Sargassum* and *Phyllospadix*. Fifty species of algæ are recorded in the present report, making 86 in all, 6 of which are new.

NON-PROLIFERATING BACTERIA.—In two papers (*J. Hygiene*, 28, pp. 139-46, 1928; and *Ann. de la Brasserie et de la Distillation*, Dec. 10, 1928), Dr. J. H. Quastel sums up the interesting results which he and his colleagues have obtained at the Biochemical Laboratory, Cambridge, by the study of non-proliferating, or, as they were at first less happily termed, resting bacteria. The organisms are used in the form of a suspension under such conditions that practically no growth occurs during the observations, and the chemical changes can thus be studied without complication. The properties of such organisms have been intensively investigated in the case of *B. coli*, which has the power of activating a very large number of substances, that is, rendering them capable of performing chemical reactions, such as reducing methylene blue, which they cannot perform in the absence of the cell. The degree of activation produced varies greatly with different substances, and, moreover, the activating powers towards different substances are very differently affected by varying modes of treatment of the organism. Thus, after treatment with toluene, glucose is no longer activated,

whereas formic acid is as powerfully activated as before the treatment Facts of this kind have led the author to the view that activation of the substrate is not necessarily due to the existence of specific enzymes He suggests that activation, which consists in a polarisation (an internal electrical change) of the substrate molecules, occurs at particular regions or centres on the surface structures (interfaces) of the cell Activation is conditioned by the specific adsorption of the substrate at the activating centre, the constitution of the substrate molecule and the nature and strength of the polarising field This theory is successfully applied to the explanation of the observed phenomena of activation and of the conditions necessary for anaerobic growth

SUGAR BEET TRIALS —The report of the second year trials of sugar beet carried out by the University of Bristol on some thirty three local farms adds very little indeed to the information already available as to the cultivation and manuring of that crop As a wide spread demonstration, this experiment may have served its purpose in giving the farmers illustrations of the cultivation and manuring of what is after all a comparatively new crop, but the results obtained must not be regarded too seriously The trials had a wide range, and covered cultivation, time of application of nitrogen, and the form of nitrogen to be applied, and on the results one draws the general conclusion that a moderate application of one or other of the soluble nitrogenous fertilisers will produce an increase in yield which is sufficiently great to make the practice profitable This cannot be considered as new information, but it may serve to confirm over a considerable area of cultivation the results of smaller individual trials carried out in various parts of Great Britain from about 1877 until the present time It is interesting to notice that the yields obtained in the trials now described are relatively high Even without nitrogen, and over a range of soils including Greensand, Bunter crag, and Old Red Sandstone, an average of 12 2 tons of washed beet per acre was obtained The average obtained by Great Britain as a whole during last season was about 8 tons of washed beet per acre Within this margin, between the eight and the twelve, lies the future of sugar beet growing in England, for unless the return per acre improves it is almost certain that the reduction of acreage which was seen last year will continue in future years and the factories will be unable to find acreage to support themselves If such trials as those reported upon from Bristol serve only the purpose of showing the growers how increased yields may be obtained without undue increase of expense, then they may well find justification for their continued existence

NEW GASTROPOD FROM THE SILURIAN OF ALASKA — From the same Upper Silurian horizon in Alaska whence he obtained the remarkable bivalve *Pycnodesma* (see NATURE, Oct 22, 1927, p 600), Mr Edwin Kirk has now described (*Proc U S Nat Mus* , vol 74, art 18) an equally interesting new gastropod to which the name of *Bathmopterus liratus* has been given The shell superficially resembles *Euomphalopterus*, but has a well defined slit band and is apparently referable to the Pleurotomariidæ, or possibly the Euomphalidæ The specimens here described and depicted came from Willoughby Island in Glacier Bay

MOLLUSCA FROM THE GULF OF CALIFORNIA AND THE PEARL ISLANDS —Mr H P Bingham, of New York, following in the footsteps of the late Prince Albert of Monaco, has been conducting expeditions in his yacht *Pawnee* and forming a collection for the purpose of oceanographic research at the Peabody Museum of Natural History, Yale University, while a *Bulletin of the Bingham Oceanographic Collection* is published in connexion therewith Although the primary object has been ichthyological research, other branches have not been passed by altogether, and Lee Boone describes in the *Bulletin* (vol 2, art 5) the mollusca dredged in 1926 during an expedition to the Gulf of California and the Pearl Islands of the Gulf of Panama. Considering the faunal richness of the region as revealed by Carpenter, Adams, and Dall, the list is a small one, but several of the species now obtained were rare, and one, *Tellina barbaræ*, from the Pearl Islands, is new Six of the species are figured, by half tone process from photographs, on three plates, which are distinctly works of art

TRINIDAD WELL WATERS —It is seldom that a study of oilfield waters is of less significance, either in itself or in its bearings on exploitation problems, than the study of petroleum in any region, and Trinidad has shown itself to be no exception to this statement The technical data requisite to geochemical interpretations of the various waters encountered in oilfields here, have taken time to accumulate, although developments have been in progress for several years past, not until now has it been possible to present a co ordinated account of the hydrology of these oilfields as a basis of geological and economic considerations Messrs J S Parker and C A P Southwell's recent paper, read before the Institution of Petroleum Technologists, emphasises such considerations by showing that, as in most other cases, chemical investigations of associated waters with oil, lead to anticipation of water bearing strata likely to be penetrated by drilling wells, with such fore warning, casing programmes can be arranged accordingly and preparations for water shut off at specified depths be initially made, the data are also available, when correctly interpreted, as confirmatory evidence of subsurface structure, particularly when the strata involved are unfossiliferous, in the event of salt water invading a well or flooding an oil sand (through leaky casing or faulty seating), the source of such water may be determinable, while the discrimination between different waters (top, intermediate, bottom, edge), when possible, elucidates both extent and trend of oil reservoir rocks and of oil accumulation therein In short, the authors demonstrate that, now the essential chemical data are available to operators in Trinidad, solution of existing problems concerned with different waters in different fields should be possible, and future developments will have an advantage of the geochemical interpretations which their researches on the subject have made possible

TRUE BEARING AND DISTANCE DIAGRAM —A true bearing and distance diagram has been devised by Mr E A Reeves and published by the Royal Geographical Society (price 7s 6d) The diagram consists of the network of a hemisphere on the stereographic projection By its aid the true bearing of any point on the earth's surface from any other point can be easily found It also gives the distance between the two stations and allows the drawing of the arc of a great circle between them The diagram should prove of great value in survey expeditions obtaining wireless time signals in connexion with longitude determination Along with the diagram and pamphlet of instructions, there is given a spare unfolded copy on strong cartridge paper with a radial pointer

THERMIONIC VALVE POTENTIOMETER FOR E M F MEASUREMENTS —Most of the applications of thermionic valves to the determination of E M F measurements have the disadvantage that they depend upon the constancy of the valve characteristics and require constant sources of filament and plate potentials An apparatus described by H M Partridge in the *Journal*

of the American Chemical Society for January is claimed to be free from these limitations and may be used with cells of very high resistance, such as a cell containing two glass electrodes, since it is essentially electrostatic in operation A four electrode valve, together with a three electrode valve, is used, the second valve acting as an amplifier giving greater sensitivity No calibration of the valves is necessary, and the E M F is read directly from a voltmeter in the grid circuit of the first valve The accuracy depends largely on the degree of precision of the voltmeter

Molecular Hydrogen —Diatomic hydrogen (H_2), although regarded until recently as a simple substance has been shown by the new mechanics to be capable of existence in two modifications which have been termed ortho hydrogen and para hydrogen by analogy with corresponding helium atoms Considerable support for this idea has already been found in spectroscopic and thermal data, and in a recent issue of *Die Naturwissenschaften* (Mar 15) it has been reported independently by A Eucken, and by K F Bonhoeffer and P Harteck, that a separation of the components can be effected A Eucken has employed the simple device of holding hydrogen under pressure for some days, at liquid air temperatures changes in the relative amounts of the two forms present being followed by the increase in the rotational component of the specific heat of the gas In addition to this method, the other investigators appear to have made use of fractional condensation on charcoal at the temperature of liquid hydrogen, as well as direct liquefaction of the gas They claim to have prepared practically pure para hydrogen, and state that it is moderately stable if stored in glass vessels under normal conditions of temperature and pressure reverting only very slowly to the equilibrium mixture on standing, but that the change can be accelerated by an increase in pressure, and that it takes place rapidly under the influence of an electric discharge, or in the presence of platinised asbestos

A Portable Electric Harmonic Analyser — R Thornton Coe gave a demonstration at the Institution of Electrical Engineers on Mar 21 on an electric harmonic analyser for electric waves The operation of the instrument depends on the principle that a dynamometer instrument only gives a steady reading when the currents in the fixed and moving coils have the same frequency A small current of about the fifth of an ampere is obtained from the voltage or the current to be analysed, and passes through the moving coil of the instrument Through the fixed coil a current which follows accurately the sine law and the frequency of which can be varied is passed At the harmonic frequencies large deflections may be produced, and as the analysing current is read on a thermal ammeter the amplitude of the harmonic can be found The chief feature of the apparatus is the method of producing the analysing current by using a special contact disc driven by a small synchronous motor actuated from the alternating current circuit One ring of contacts is used for each harmonic A tuned circuit is used for improving the wave shape of the analysing current The instrument obtains each harmonic separately from steady readings on two instruments It is claimed that by its use alternating current waves can be analysed up to the forty ninth harmonic It is of importance in practice to determine the wave shapes produced by electric generators If an appreciable harmonic be present in the limits of audition, annoying interference with neighbouring telephone circuits may ensue This can generally be remedied by slightly modifying the generator circuits

Atomic Weight Reports —A correspondent points out that the German values for atomic weights given under the above heading in the issue of Nature for Mar 9, p 390 (in which the value for phosphorus should read 31 02, and not 31 62) are mainly identical with the values adopted in 1925 by the International Commission on the Chemical Elements in its atomic weight report which, though not an annual publication, was the successor to the former annual report of the International Committee on Atomic Weights It thus appears that the German Commission has retained the international values for the elements mentioned (*loc cit*), whilst the English sub committee has used F W Clarke s values

Distillation of Wood Tar in Hydrogen —Many years ago the interest of the Russian school of organic chemists in pyrogenic reactions was well known, and that this interest still continues has been shown by the work which has been published in recent years by W N Ipatiev from the Academy of Sciences in Leningrad The effect of heating organic substances under pressure in the presence of hydrogen and of alumina and iron catalysts has been investigated, and the results of this treatment on wood tar and tar oil are now described (*Berichte*, vol 62, p 401 February 1929) It is found that the use of hydrogen results in an increase in the yield of liquid products which are richer in hydrocarbons and low boiling fractions than the products of ordinary cracking Correspondingly there is a decrease in the proportion of unsaturated compounds formed, and this is reflected in the loss of the unpleasant smell which is a disadvantage of the ordinary product and in the absence of a tendency to darken on keeping The authors Ipatiev and Petrov, suggest that the new products might be used for extraction or lubricating purposes

The Nickel Chromium Plating Process Chromium is being extensively used instead of nickel as a protective coating for iron, not only for the purpose of producing a highly lustrous and durable surface, but also for the surface hardening of bearings That it has not yet displaced nickel is due to the difficulties encountered in electroplating In an article in the *Chemiker Zeitung* of Mar 13, Prof Pfanhauser director of the Langbein Pfanhauser Werke A G, Leipzig and Vienna, deals with these difficulties and describes how they have been overcome by a method which is protected by the patents of the Chrom Interessen Gemeinschaft By using a high current density, the time required to produce a stable and highly resistant coating of chromium has been reduced to five or ten minutes, the original iron or brass having previously received a layer of nickel 0 02 0 025 mm thick The advantages of using an intermediate layer of nickel are twofold, for not only is the cost of plating very greatly reduced, but also the risk of corrosion of the iron or brass by traces of chromic acid, deposited with the metal, is obviated The chief disadvantage has hitherto been the tendency for both metals to peel after a short time The reason for this is that some hydrogen is deposited with the metals at the cathode In order to overcome this defect, it is necessary in the first place to pay special attention to the deposition of the nickel, which must be sufficiently thick, and at the same time poor in hydrogen, to be able to absorb by diffusion the gas which is associated with the chromium layer Old fashioned nickel plating processes may be quite unsuitable for the purpose, and the solutions require very careful control A further source of trouble is due to traces of grease or oxide on the original metal, particularly on brass, which will ultimately cause blistering

Geological History of the Atlantic Ocean[1]

THE Atlantic is the best test case for the theory of the permanence of the ocean basins According to one view, the Atlantic trough is a primeval geographic feature and dates back to the pre Palæozoic According to an alternative view, it has been repeatedly so broken up by lands trending east to west across it that there has often been no sea entitled to the name of the Atlantic

The Icelandic Ridge, the northernmost of these cross lands, is generally accepted, and it was probably finally severed between the Upper Palæolithic and the Neolithic This land is shown by varied evidence from different geological periods to have extended as far south as a line from Newfoundland to Ireland or to the Azores It formed the northern shore of the Tethys

The main issue regarding the Atlantic relates to the southern side of the Tethys and the Brazilio Ethiopian land That the South Atlantic was occupied by land in the Palæozoic era is indicated by the absence of marine rocks from most of both coasts From Upper Carboniferous to Lower Jurassic times, Brazil and Africa were parts of Gondwanaland and a southern fauna and flora ranged through both The invasion of this land by the sea began in the Middle Cretaceous Period, with gulfs from the Mediterranean which reached Brazil and Angola they were closed to the south, as the marine fauna of Cape Colony is distinct and ranged westwards through Chile, and as the fresh water fauna was continuous between Africa and South America

This continuity is shown by the river fish porcupines, lizards, snakes and many invertebrates, of groups that were in existence in the Lower Kainozoic era The evidence shows that the connexion lasted until the end of the Oligocene, but it cannot have lasted much later, as the more specialised mammals and birds—for example, the humming birds—did not use it as a land bridge

The existence of this land connexion in Oligocene times is shown by the occurrence of the same shallow water marine animals in the West Indies and in the Mediterranean Some of them might have crossed by a chain of islands, but that the land was continuous is shown by the marine mollusca of the West Indies and the Mediterranean being distinct from those in the south The first commingling in South America was in the Upper Miocene (Entrerios Beds), according to H von Ihering A slight temporary land connexion was established in the Upper Miocene, as shown by the migration of *Hipparion gracile* to Europe and of African antelopes to the United States

This land connexion was severed too early to have served as Atlantis, though the Canaries may have been joined to the mainland up to the Pleistocene There is no geological evidence of any land connexion of Africa and South America in the time of man

The Atlantic is a relatively young geographical feature and due as held by Suess, to the growth of two gulfs, which projected northwards and southwards from the Tethys These gulfs were formed by subsidences which began in the Middle Cretaceous and have continued to the Pleistocene, and they finally united the Arctic, the North Atlantic (Poseidon), and the Nereus or the South Atlantic The Atlantic trough is the greatest of meridional geographical features, and is due to the collapse of a belt of the crust along faults and tensional fractures connected with the pressure of South America westward against the Andes

[1] From the presidential address to the Geological Society of London delivered by Prof J W Gregory F R S on Feb 15

Cylinders for the Storage and Transport of Gases[1]

THE publication of the third and fourth reports of the Gas Cylinders Research Committee of the Department of Scientific and Industrial Research completes the work of that Committee The first report dealt with ordinary commercial cylinders for permanent gases, the second with the periodical heat treatment of carbon steel cylinders, and recommended that such cylinders should be made of 0 45 per cent carbon steel as an alternative to the 0 25 per cent carbon steel approved in 1895, whereby the working stress in the cylinders would be raised from 8 to 10 tons per square inch, while the weight would be reduced by about 20 per cent The first report (see NATURE, 109, 460, 1922) is now out of print, but a revised summary of the recommendations it contained has been issued lately

A further reduction of weight to one third of that recommended by the 1895 Committee is possible by the use of alloy steels This is called for in the case of cylinders used for medical, aeronautical, and mine rescue work, and the question of constructing cylinders of duralumin and alloy steels containing nickel, chromium, and molybdenum has been examined by the Committee The third report gives details of this investigation Commercial and mechanical difficulties rather restricted the scope of the work, and alloy steel cylinders alone have been investigated properly The Committee recommends the use of nickel chromium molybdenum steel cylinders for the storage and transport of 'permanent gases, the steel to have the following composition Nickel, 2 5 per cent chromium, 0 6 per cent, molybdenum, 0 6 per cent manganese 0 6 per cent, carbon, 0 3 per cent silicon 0 15 per cent, sulphur, 0 4 per cent (max) and phosphorous, 0 03 per cent (max), and the remainder iron and to have the following mechanical properties Ultimate tensile strength, 55 65 tons per square inch yield stress, not less than 45 tons per square inch an elongation not less than 18 per cent on 2 inch gauge length Seamless and weldless finished cylinders of about 20 cubic feet of gas capacity are required to be subjected to a hydraulic proof pressure of 2700 lb per square inch, to stand a pressure of 2550 lb per square inch and show no sign of leak, and to withstand the impact of an armour piercing bullet (Mark vii P) without bursting when filled with air at a pressure of 1800 lb per square inch The thickness of the cylinder wall for cylinders of 4 inch outside diameter must not be less than 0 080 inch, and particles of shale, oil, grit, filings, etc, must be carefully removed from the cylinder They are to be subjected to the hydraulic test at least once in every two years

The considerations that are of importance in the case of cylinders used for the storage and transport of *liquefiable* gases are radically different from those ruling in the case of permanent gases In the former case, so long as the cylinder is not *completely* filled with liquefied gas, the internal pressure is the saturation pressure, and this in general is quite low and

[1] Department of Scientific and Industrial Research Ordinary Commercial Cylinders for the Permanent Gases. Summary of Recommendations (Revised) Pp iii+7 4*d*. net. Third Report of the Gas Cylinders Research Committee (Alloy Steel Light Cylinders) Pp iii+74+13 plates 2*s* 6*d*. net Fourth Report of the Gas Cylinders Research Committee (Cylinders for Liquefiable Gases) Pp v+151 4*s* net (London H M Stationery Office 1929)

increases *relatively* considerably, but *absolutely* only slightly with rise of temperature Liquefied gas, however, has a relatively high coefficient of thermal expansion, and unless a sufficient free space is left in filling a cylinder, dangerous pressures may be developed owing to the cylinder becoming filled with liquefied gas on rise of temperature Cylinders for the permanent gases are designed on the basis that the stresses in a cylinder wall due to internal pressure are limited say, to one quarter of the ultimate strength of the material The same basis, applied to cylinders for liquefiable gases, would result in the production of cylinders altogether too fragile for commercial purposes

These considerations and others are set out in detail in the very interesting fourth report of the Committee The storage and transport of liquefied sulphur dioxide, ammonia, chlorine, methyl and ethyl chlorides, hydrocyanic acid, phosgene, carbon dioxide, nitrous oxide, and ethylene are considered Acetylene was excluded from the Committee s terms of reference It is recommended that cylinders for the transport of these gases should be made of seamless tubes of carbon steel produced by the acid or basic open hearth process and having the following approximate composition Carbon, 0 20–0 25 per cent sulphur, not exceeding 0 045 per cent phosphorus not exceeding 0 045 per cent manganese 0 45 0 75 per cent silicon not exceeding 0 2 per cent, and the rest iron Alloy steel is not to be used The thickness of the cylinder wall is to be dependent upon the maximum internal pressure and the external diameter of the cylinder, and formulæ for deducing such thickness are given in the report After manufacture, cylinders are to be heated uniformly at 860° 890° C and allowed to cool in still air

Filling ratios for various pressures in temperate and tropical climates for each of the gases are tabulated Finished cylinders are to be subjected to specified tensile and hydraulic stretch and flattening tests and are to be provided, as in the case of cylinders for containing ‘permanent’ poisonous or inflammable gases, with completely protected valves which must be left handed in the case of cylinders containing inflammable gases Hydrocyanic acid must not be stored for more than 8 months its purity must be at least 98 per cent and it should be stabilised to prevent polymerisation The valves of cylinders for storing carbon dioxide may be fitted with a safety device, for example a copper or vulcanite disc forming a gas tight joint with the valve seat

The reports contain valuable appendices relating to tests of cylinders the determination of some of the physical properties of commercial samples of sulphur dioxide, ammonia chlorine methyl chloride, carbon dioxide, nitrous oxide ethylene hydrocyanic acid, and ethyl chloride

Vertebrate Fossils from Glacial and Later Deposits in Scotland [1]

THE work referred to below is an important contribution to our knowledge of the vertebrate fossils from the glacial and associated post glacial beds of Scotland in the Hunterian Museum, University of Glasgow This monograph was planned twenty years ago Various causes have contributed to the delay in publishing but Prof Gregory and Dr Ethel Currie are to be congratulated on finally bringing the work to conclusion

Several eminent specialists have collaborated in examining and naming different parts of the collection The resulting publication however, is more than a catalogue of fossils Detailed and critical descriptions of specimens are first of all given, all the more important examples being figured either in the text or on plates There follows a series of notes on the localities and geological horizons of the different occurrences In one or two instances the views expressed herein are matters of controversy, but the authors have been careful to direct attention to other opinions It may be noted, for example, that Prof Gregory s belief in the marine origin of Boulder Clay is not generally accepted in Scotland In addition the interpretation of the evidence as to the exact position of the Cowdon Glen deposits is at variance with that of some other eminent Scottish geologists It appears in this connexion that Craig s description of the glacial sequence in this locality has been slightly misread Prof Gregory classes the deposits as Neolithic, but the alternative reading would make them older

The next section of the monograph contains a table showing the distribution in time of the characteristic Scottish mammal remains, with a proposed correlation with the Thames Valley sequence No Scottish mammals earlier than Lower Mousterian are known Deposits of this age in Scotland are correlated in time with the Late Middle Terrace of the Thames Valley, and the period of maximum glaciation in both Scotland and England It must be noted, however, as the authors point out, that vertebrate fossils in the glacial and later deposits have been found in very few localities in Scotland, and consist only of isolated fragments Nothing occurs corresponding to the rich Pleistocene vertebrate faunas of south east England

The monograph concludes with a comprehensive bibliography We agree with the authors in hoping that its publication will stimulate interest, and result in further chance discoveries being carefully recorded and the specimens placed in suitable keeping

[1] Monographs of the Geological Department of the Hunterian Museum, Glasgow University 2 The Vertebrate Fossils from the Glacial and Associated Post-Glacial Beds of Scotland in the Hunterian Museum University of Glasgow, and their Evidence on the Classification of the Scottish Glacial Deposits By Prof J W Gregory and Dr Ethel D Currie Pp vi+26+3 plates (Glasgow Jackson Wylie and Co, London Simpkin Marshall Ltd 1928) 7s 6d net.

H M Dockyard Schools and Naval Architecture

MR A W JOHNS concludes a series of six articles in *Engineering* for Mar 29, on "The Dockyard Schools and the Second School of Naval Architecture," a series which fills in a gap in the history of the Admiralty system of training shipwrights and naval architects Though all Boards of Admiralty have not been possessed with equal zeal in such matters, generally speaking the Admiralty has been a pioneer in technical education Mr Johns' articles necessarily present but one aspect of their activities, which to day range from the training of bandsmen to courses of strategy for captains and admirals Only so recently as September 1925, Sir W J Berry and Engineer Vice Admiral Sir Robert Dixon gave an account of the Admiralty system of higher education for naval constructors and engineers officers to the British Association, and they stated that it is no exaggeration to say that during the last half century nearly all advances in warship design have been originated by officers who have passed through the training at Kensington or Greenwich

Not only have Admiralty students been responsible for advances in warship design, but also many of them have become associated with great shipbuilding firms,

with Lloyds' Register, and with foreign navies, while nearly all the occupants of the various chairs of naval architecture in Great Britain have been held by men whose professional training began in H M Dockyards or at one of the schools maintained by the Admiralty

The dockyard schools at Portsmouth, Devonport, Chatham, and elsewhere for the education of apprentices, have a continuous history from 1843, and Mr Johns says they "may be placed amongst the most efficient technical institutions in the country" In the first years of their existence they were inspected six times by Canon Moseley, the mathematician, and to his suggestions may be traced many of the improvements afterwards made The Schools of Naval Architecture were separate institutions, the first (1811–1832) and the second (1848–1853) being at Portsmouth, the third (1864–1873) at South Kensington, the fourth and still existing one being founded at Greenwich Royal Naval College in 1873 Of the first, Mr Johns gave an account in *Engineering* in 1926, the third was the subject of an article by Sir William Smith in the same journal in July 1923, and Mr E L Attwood read a paper to the Institution of Naval Architects in 1905 on the work at Greenwich Sir William White also referred to the work done at South Kensington and Greenwich in a paper read at the jubilee meeting of the same body in 1911

Mr Johns in his articles gives an interesting account of the development of the dockyard schools and of the Second School of Naval Architecture, otherwise known as the Central Mathematical School, and recalls some of the important work done by the professors, masters, and pupils, such as Dr Woolley, Rawson, Sir Edward Reed, and Sir Nathaniel Barnaby, the last two of whom held the responsible post of Chief Constructor of the Navy A review of the progress of the various schools and of the careers of those who have passed through them bears eloquent testimony to what can be accomplished by a government department desirous of encouraging talent and industry and of obtaining for itself and the nation at large, workmen and officers with a high standard of professional and technical knowledge

Studies on the Polysaccharides

At a meeting of the London Section of the Society of Chemical Industry on Mar 4, Prof A R Ling, director of the British School of Malting and Brewing, University of Birmingham, described results of recent researches into the structure of starch and glycogen, conducted by himself and his collaborators

In addition to amylose and amylopectin, the two main constituents of the starch of potatoes, arrow root, etc, the granules obtained from cereals contain a third substance, amylohemicellulose Amylose and amylopectin are hexa amyloses partially esterified as calcium phosphate esters, whilst amylohemicellulose is a silicic ester of amylose Hydrolysis of starch paste with barley diastase converts amylose quantitatively into maltose, whereas amylopectin yields soluble $\alpha\beta$ hexa amylose, which is resolved in turn by malt diastase to various glucose derivatives Amongst these are found glucosido maltose and isomaltose Recent study of enzyme action upon these two products has revealed the fact that both possess α linkages, and not β linkages as was hitherto supposed

Prof Ling has also produced evidence to show that if glycogen, a polysaccharide widely disseminated through the animal kingdom and found also in fungi and in yeast, is not identical with amylopectin, as suggested by Pringsheim, the two compounds are certainly very similar Samples of glycogen after hydrolysis by malt diastase gave products which could be investigated with the help of the osazone reaction Two compounds were isolated, namely, a disaccharide and a non reducing sugar The former agrees in physical properties with isomaltose and possesses a γ (1 4) ring It seems probable that all the oxide rings in glycogen and amylopectin are of this type and that the conversion of glycogen into lactic acid in the muscles during contraction is best explained by assuming that the glucose involved possesses the γ structure

The lecture was followed by an account by Dr F W Norris, of Prof Ling's department, of recent researches on pectin, an important constituent of fruit jellies After reviewing earlier work on the subject, Dr Norris referred to Ehrlich's resolution of pectic acid into arabinose, galactose, and tetragalacturonic acid In 1925, Nanji, Paton, and Ling proved that these substances are linked in the proportion of 1 1 4 as anhydrides in a ring structure, the acid carboxyl groups being free An attempt to remove the acid groups, in order to produce a hemicellulose, gave an unexpected result, the product actually obtained being pure galactose galacturonic acid The adoption of the ring or hexagon formula helped to throw some light upon the interpretation of analyses of methoxyl groups, and it seems probable now that the predominating unit in soluble pectin is trimethylpectic acid, which is present in fresh orange juice Reference was made to recent work by Candlin and Schryver, who obtained a hemicellulose by the action of alkali on pectic acid Schryver has suggested a new class name—the polyuronides—for all these compounds

A wide and interesting field of research has been opened up and much remains to be done to clear up many existing perplexities

University and Educational Intelligence

London —The annual dinner of the fellows of University College will be held at the College on Tuesday, April 30, in commemoration of the laying of the first stone of the College buildings by H R H the Duke of Sussex on April 30, 1827 Prof F W Oliver, Quain professor of botany in the University, who was elected a fellow of the College so long ago as 1886, will preside

The following courses of free public lectures are announced at Bedford College for Women, at 5 15 on April 29 and May 1, "Abolishing the Arctic," and "The Northward Course of Empire," by Dr V Stefansson, at University College, at 5 30 on April 29, May 7 and 13, "Geometry a Brief Review," by Prof H F Baker, at University College, at 5 15 on April 29 and 30 and May 1, "Drug like Actions of Some Food Constituents," by Prof E Mellanby, at University College, at 5 on May 2, 9, 16, 23, and 30, and June 6, "Special Sense Physiology," by R J Lythgoe, at St Thomas's Hospital, at 5 on May 2, 9, 16, 23, and 30, and June 6, "Dietetics," by Prof S J Cowell, at University College, at 4 on May 3 and 10, "Some of the Sequels of Epidemic Encephalitis (Lethargica)," by Prof A J Hall

Applications for agricultural scholarships and agricultural and veterinary research scholarships are invited by the Ministry of Agriculture and Fisheries Form A 472/T G for the former and form 900/T G. for the latter may be obtained from the Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S W 1 The completed forms have to be returned by June 15

Calendar of Patent Records

April 22, 1823—The first patent for a roller skate was the English one granted to Robert John Tyers, fruiterer of Piccadilly, on April 22, 1823 The skate had a single line of wheels or rollers, which either were of graduated diameter or were so fitted that their lower edges lay on the line of a circle

April 23, 1784—The well known cabinet lock of Joseph Bramah—the first of the revolving barrel type—was patented on April 23, 1784, and remains unaltered to the present day It was one of the first to give real security against being opened by a false key, but that it, like most locks, could be picked by an expert was proved when the American A C Hobbs took up Messrs Bramah's challenge in 1851 and succeeded in opening the lock, though only after 53 hours' work

April 23, 1793—Sir Samuel Bentham—a brother of Jeremy—is one of the most noted of English inventors His many inventions, not all of which were patented, cover a wide field, but most of his important work was done in connexion with the naval dockyards, where he introduced reforms not only in the methods of shipbuilding but also in office and workshop administration and practice His most famous patent is No 1951, dated April 23, 1793, the specification of which is a valuable treatise on the application of machinery to the working of wood and metal

April 23, 1884—April 23, 1884, is the date of Sir Charles Parsons' patents for the steam turbine The engine was first used for driving dynamos in electricity works, where within a few years its use decreased the coal consumption by one half The first application to steamships was in the *Turbinia*, which was built in 1894 and attained a speed of more than 32 knots The engine of the *Turbinia* is now in the Science Museum

April 25, 1793—On April 25, 1793, there was granted to Captain Joseph Huddart a patent for his new method of making rope cable, in which all the yarns are disposed in concentric cylindrical layers about a centre yarn, an arrangement designed to give a more equable distribution of strain upon the yarn

April 25, 1863—Linoleum—both the material and the word—was the invention of Frederick Walton, who made his first application for a patent for the new floor cloth on April 25, 1863 There has been little change in the process of manufacture since its first commercial production at Staines

April 26, 1814—The sewing machine did not become commercially successful until Elias Howe's United States patent of 1846, but there were several prior inventors who can claim consideration One of these is Josef Madersperger, of Vienna, who applied to the Emperor Francis I for an Austrian patent for a sewing machine on April 26, 1814 A patent for six years was granted to him early in the following year, but the machine was never put into practical use Madersperger's original model was shown at a meeting of the Nied Österreichischer Gewerbe Verein in 1840 and secured for the inventor the society's medal, but in spite of this recognition Madersperger died in extreme poverty The model is now in the Technical Museum at Vienna

April 27, 1879—Electricity was first used for lighting railway carriages by the London, Brighton, and South Coast Railway, which in 1881 fitted up a Pullman car with an accumulator installation A system employing a belt driven dynamo on one of the carriages for supplying current to Geissler tubes throughout the train had, however, been patented in Germany by E Hinkefuss and Gustav Wesel, engineers of Breslau, on April 27, 1879

Societies and Academies

London

Geological Society, Mar 20 **Sir Douglas Mawson** Some South Australian algal limestones in process of formation A record of three different types of limestone, now actually in process of formation under the influence of plant growth, occurring in the south eastern region of South Australia In each of the localities examined, whether inundated in winter only or permanently inundated, the formation of limestone is being determined by blue green algæ—**Arthur W Groves** The unroofing of the Dartmoor granite, and an outline of the distribution of its detritus in the sediments of southern England A systematic outline mineralogical survey has been made of the sediments of southern England, from the base of the Permian in Devon (Watcombe Clay) up to the Lenham Beds of the North Downs The minor intrusions above the granite were being rapidly eroded in Permo Triassic times, but there is no evidence of the actual granite being exposed at that period No proof has been obtained of direct derivation of detritus from the Dartmoor granite in the Jurassic rocks The earliest evidence of the exposure of the granite is in late Wealden times Throughout Upper Cretaceous times—particularly during the Selbornian epoch—the Dartmoor granite contributed enormous quantities of detritus to the sediments of southern England, reaching as far afield as Kent and Oxfordshire, and perhaps farther The Cornish Pliocene was largely derived from the Cornish granites The St Keverne outlier is mainly derived from the Falmouth and Bodmin masses, and yields no evidence of Dartmoor detritus A number of new occurrences of dumortierite are recorded

Society of Public Analysts, April 3—**L H Lampitt, E B Hughes**, and **H S Rooke** Furfural and diastase in heated honey Modifications of Fiehe's test and the aniline acetate test for furfural have been devised If honey gives pronounced reactions with both of these tests it is probably adulterated, unless there is evidence that it has been strongly heated Such honey has usually been found to be caramelised and unfit for use Honey contains two diastatic enzymes, for it reacts with starch, yielding both dextrins and reducing sugars If it is heated above 85° C its diastatic activity is very rapidly destroyed—**J W Haigh Johnson** Further notes on methods of sewage and water analysis, anti oxidation and stabilisation of pollution Comparative results on river waters have shown that the Graph Standard method is much to be preferred to the Royal Commission's test Three main types of biological oxidation curves are recognisable for polluted liquids (1) Unstable type, characterised by very rapid, fairly uniform absorption of not more than five days' duration, followed by (2) semi stable type, having greatly diminished but very uniform oxidation rate, of indefinite duration, until (3) nitrification supervenes From one third to two thirds of the chemically determined organic matter is recovered from sewage during purification without any appreciable absorption of oxygen The effect of oxygen is apparently to oxidise unstable substances, whilst semi stable substances are stabilised and precipitated as a relatively non oxygen absorbing mud of increasing stability—**B J F Dorrington** and **A M Ward** Potassium cyanate as a reagent for the detection of cobalt Potassium cyanate reacts with cobalt to form a blue complex The test, which is most sensitive when the reagent is used in alcoholic solution, will detect cobalt in a one hundredth molar solution of cobalt nitrate

EDINBURGH

Royal Society, Mar 4 —**Hans Przibram** Quanta in biology The movements of cold blooded animals follow van 't Hoff's law, so also do many other processes of the living organism It is suggested that the dissociation of ultimate particles to which the characteristics of life are attached is responsible for the exhibition of this phenomenon A statistical conception which accounts for the decrease of the temperature coefficient with the raising of the temperature is developed Przibram's work on the discontinuous growth of the Mantidæ and the conclusions of Koltzoff and Heidenham lead to an attempt to introduce a more systematic notion of fundamental quanta in biology

PARIS

Academy of Sciences, Mar 11 —**R Bourgeois** Concerning the programme of the expedition organised by the Bureau des Longitudes for the observation of the total eclipse of the sun of May 9, 1929 The station chosen for the observatory is the island of Bai Kan an outline of the scheme of observations proposed is detailed —Jules Richard was elected *correspondant* for the Section of Geography and Navigation in the place of the late Roald Amundsen —**Jacob** Addition to the note "The application of the generalised integrals of Fourier to the calculus of probabilities" **A Th Masloff** An application of the theorem of Eisenhart —**Bertrand Gambier** Imaginary deformations of real surfaces cyclic systems —**Marcel Vasseur** The relations between the two focal sheets of a rectilinear congruence —**C Popovici** Functional equations and their parallelism with differential equations —**Georges Giraud** The solubility of the generalised problem of Dirichlet —**Georges Calugaréano** The calculation of the M exceptional values of integral functions of finite order —**Victor Vâlcovici** Generalisation of the theorem of Kœnig —**Benjamin Jekhowsky** Calculation concerning the positions of the minor planets —**L d'Azambuja** The structure of the solar chromosphere —**L Driencourt** The choice of the projection to be adopted for aerial navigation maps —**Vasilesco Karpen** Demonstration of the relations of Maxwell Clausius and of Clapyron —**S Piña de Rubies** The arc spectrum of samarium Measurements made at the normal pressure between 3100 A and 2750 A —**Jean Savard** The ultra violet absorption spectra of the ortho, meta, and para cresols —**G Jausseran** The evolution of the latent image The relations between the density of the image and the time elapsed between the exposure and the development are shown graphically The effects of the evolution of the latent image are considerable and must be taken into account in the photographic comparison of two non simultaneous luminous intensities —**G Athanasiu** The inversion of the photo voltaic effect by the OH and H ions —**Eugène Cornec and Henri Krombach** The ternary system water, sodium nitrate, potassium nitrate This system has been studied through a wide range of temperatures a general outline of the results is given —**Horacio Damianovitch** The action of helium upon platinum The product obtained by the action of helium upon platinum under the influence of a moderate electric discharge at low pressures presents properties clearly distinct from those of the metal itself, and it retains helium in a fairly stable form —**Ed Bayle and L Amy** The estimation of the hydrofluosilicic anion and that of fluorine in general —**Marcel Godchot and Mlle Cauquil** The methylation of cycloheptanone This ketone, treated with sodium amide and methyl iodide, gives rise to α, α dimethyl cycloheptanone and an α methylcycloheptanone, the first being formed in relatively small quantity —**M Battegay, H Buser, and E Schlager** A crystallised acetin and diglycide **R Cornubert and Ch Borrel** Contribution to the study of the ketonic function —**Mlle E Jérémine and P Fallot** The presence of a variety of jumillite in the neighbourhood of Calasparra (Province of Murcia) **Alberto Betim** The theory of Wegener in the light of some geological observations concerning Brazil —**G Baeckeroot** The extension of the *Pierre de Stonne* in the Grand Duchy of Luxemburg —**Albert Michel Lévy** The existence of a level characterised by touchstones with Radiolaria at the base of the marine Carboniferous, in le Morvan —**M Couvreur** The general structure of the shells of gastropods —**C E Brazier** Actinometric data for the region of Paris from measurements made at the Observatory of Parc Saint Maur The average quantity of heat received in one year by one square centimetre of the earth's surface in the climate of Paris is 93 large calories —**Marcel Mascré** New remarks on the fixation of the chondriome of the plant cell —**Guilliermond** New observations on the vital coloration by neutral red in plant cells —**Georges Montandon** An ape of anthropoid appearance in South America —**Ph Joyet-Lavergne** The relations between metabolism and cytoplasmic sexualisation —**Raymond-Hamet** Tropine and atropine —**René Hazard and Michel Polonovski** The rôle of the tertiary amine function in the dipiperidine nucleus —**Raymond Poisson** *Paracoreomyces Thaxteri*, a parasite of *Stenocorixa protrusa* —**F Diénert and P Etrillard** The sterilisation of water by chlorine The experiments described are opposed to the view that the sterilisation of contaminated water is due to an abiotic radiation, but are in agreement with the older hypothesis of direct action of the chlorine on the micro organism

GENEVA

Society of Physics and Natural History, Feb 7 —**Ed Parejas** Geological observations in Corsica (1) The Razzo Bianco near Venaco The alpine dynamic metamorphism has determined in the limestone elements of the base of the nummulitic conglomerates of Venaco a fibrous texture of the calcite, and this is again met with in the limestones of Razzo Bianco The latter must therefore have been marmorised during the Tertiary Alpine paroxysm A later and weaker thrust has carried the Razzo Bianco limestones on to the granite —**R Wavre** A new method in geodesy The author shows that, starting with a method that he has given in his earlier communications, some important classical results of higher geodesy can be co ordinated and new results obtained This method consists essentially in employing a development in a convergent series where Laplace and Poincaré made use of a divergent development Hence the method conforms to the desideratum formulated by Tisserand The exact formula for the flattening is also given by M Wavre —**W Schopfer** Theoretical remarks on the question of the metabolism of the sexes The author examines the old theory of the metabolism of the sexes (♀ anabolism and ♂ catabolism), he shows that if, when expressed too rigidly, it appears inexact, nevertheless modern researches give it some experimental support The sexual metabolic differences occur even in the Mucorineæ, where the morphological differentiation of the sexes is scarcely noticeable

VIENNA

Academy of Sciences, Jan 17 —**A Zinke and N Schniderschitsch** Researches on perylene and its derivatives (22) —**A Pischinger and D Boerner-**

Patzelt The sarcosome problem When the surviving thorax muscle of insects was observed fresh, there was no trace of granulations until Ringer's solution was run under the cover glass But all sections of fixed insect thorax muscles showed sarcosomes —**H Hahn** The integral concept —**K Menger** (1) The new definition of arc length —(2) A further generalisation of the concept of length

Jan 24 —**A Tornquist** The perimagmatic lead copper silver zinc ore deposits from Offberg in the Remschnigg —**L Kober** The Salzberg of Hallstatt

WASHINGTON, D C

National Academy of Sciences (*Proc*, Vol 15, No 1, Jan 15) —**Arthur G Scroggie and George L Clark** The crystal structure of anhydrous silicotungstic acid and related compounds, and their probable molecular formulæ Acids with 7, 8, and 10 tungsten atoms have been isolated Those with 8, 10, and 12 tungsten atoms crystallise as body centred cubes, there being a central stabilising SiO_4 group —**Wilder D Bancroft and H L Davis** Binary solutions of consolute liquids —**Herbert J Brennen** A new equation of state A mathematical development of van der Waals' equation —**Duncan A MacInnes and Irving A Cowperthwaite** The effect of diffusion at a moving boundary between two solutions of electrolytes In measuring the transfer number of an electrolyte by timing the moving boundaries, interrupting the current for periods up to 30 min has no effect on the results The boundary fades away, but gradually reappears on switching on the current Diffusion occurs, but the potential gradient set up quickly restores the sharp boundary —**Carl Barus** Adiabatic expansion in case of vanishing increments —**Paul S Bauer** The condition of self oscillation of a general triode system A mathematical discussion —**Benedict Cassen** On the symmetry of protonic wave functions —**W Uyterhoeven** Positive ion currents in the positive column of the glow discharge in the noble gases —**E L Kinsey** Note on the *D* line excitation by the green sodium band and the dissociation potential of sodium vapour (see NATURE, June 9, 1928, p 904) —**Einar Hille and J D Tamarkin** On the summability of Fourier series (Second note) —**H S Vandiver** Summary of results and proof concerning Fermat's last theorem (Third paper) —**Dietrich C Smith** The direct effect of temperature changes upon the melanphores of the lizard *Anolis equestris* Between 8° and 43° C their behaviour in isolated pieces of skin is controlled by illumination Outside these limits, cold generally produces 'expansion,' and further heat 'contraction,' independently of illumination —**Henry B Ward** Further studies on the influence of a power dam in modifying conditions affecting the migration of the salmon Sockeye salmon migrating up the Baker River seem to avoid the fish ladder provided at the dam, possibly owing to some bad quality of the water The down stream movement of young sockeyes seems to be decreasing, they may be forming a physiologically landlocked race in the artificial lake caused by the power dam —**David I Macht** Pharmacological synergism of stereoisomers When the effect of a combination of two or more drugs is different from the added effects of the separate drugs, this is termed synergism Many drugs show the effect The different optical forms of nicotine, epinephrin, camphor, hyoscyamin, hyoscin, quinin, and cinchonin were tested Generally the combination of an optical pair gives a much greater effect than either separately If animal or plant cells have receptor groups of a lævo and dextro type, mixtures of optical pairs have two points of attack, thus accounting for the effect.

Official Publications Received

BRITISH.

Report of the Department of Industries Madras for the Year ending 31st March 1928 Pp. vii+103 (Madras Government Press.) 12 annas.

Journal of the Indian Institute of Science. Vol 11A Part 19 i. Contributions to the Study of Spike Disease of Sandal (*Santalum album*, Linn), Part 4 Chemical Composition of Healthy and Spiked Sandal Stems, by D A Rama Rao and M Sreenivasaya ii Contributions to the Study of Spike-Disease of Sandal (*Santalum album*, Linn), Part 5 Transmission of Spike by Budding by M Sreenivasaya and G Gopalaswami Naidu Pp 241 247+8 plates (Bangalore) 1 rupee

Legislative Assembly (Second Session), New South Wales Report of the Director General of Public Health New South Wales, for the Year 1927 Pp vi+408 (Sydney N S.W Alfred James Kent) 10s

The Scientific Proceedings of the Royal Dublin Society Vol 19 N S. Nos 14 18 14 On the Structure of *Palæacis* by Dr Louis B Smyth, 15 William Higgins, a Pioneer of the Atomic Theory by Dr J Reilly and D T MacSweeney 16 The Integration of Light by Photo-electrolysis by Dr W R G Atkins and Dr H H Poole 17 A Note on Gas Analysis, by James T Donnelly C Hamilton Foott and Dr J Reilly 18 The Photo electric Measurement of the Illumination in Buildings by Dr W R. G Atkins and Dr H H Poole Pp. 125 188+plates 6-8 (Dublin Hodges, Figgis and Co London Williams and Norgate Ltd) 5s.

The Realist a Journal of Scientific Humanism Published for the Realist Publishing Co Ltd Vol 1 No 1, April Pp 192 (London Macmillan and Co Ltd) 2s net

Far Eastern Association of Tropical Medicine Transactions of the Seventh Congress held in British India, December 1927 Edited by Lieut. Col J Cunningham Vol 1 Pp xi+865+61 plates (Calcutta Thacker's Press and Directories Ltd)

Transactions of the Optical Society Vol 30 No 2 1928-29 Pp iv+49 100 (London)

The Institute of Physics List of Members, January 1, 1929 Pp 24 (London)

Transactions of the Rochdale Literary and Scientific Society, with a Record of the Proceedings of the Jubilee Celebrations Vol 16 1926 1928 Pp 128+xlvi (Rochdale)

Journal of the Chemical Society containing Papers communicated to the Society March Pp iv+357 589+x (London)

Report of the Marlborough College Natural History Society for the Year ending Christmas 1928 (No 77) Pp 84+3 plates (Marlborough) 5s to Members 3s

Transactions of the Royal Society of Edinburgh Vol 16 Part 1 No 8 The Oogenesis of Carcinus mœnas Penn with special reference to Yolk Formation By L A. Harvey Pp 157 174+2 plates (Edinburgh Robert Grant and Son London Williams and Norgate Ltd) 3s

Commonwealth of Australia Council for Scientific and Industrial Research Pamphlet No 10 The Health and Nutrition of Animals Reports by Sir Arnold Theiler and Dr J B Orr Pp 76 Bulletin No 40 Observations on the Hydatid Parasite (Echinococcus granulosus) and the Control of Hydatid Disease in Australia. By I Clunies Ross Pp 68 (Melbourne H J Green)

The Indian Forest Records Entomology Series Vol 13 Part 6 On some New Indian Coleoptera, Hemiptera and Thysanoptera Part I Neue Indische Lyciden nebst faunistischen Bemerkungen (Lycidae Col) von R Kleine Part II A new Agrilus from India (Buprestidae Col) by A Thery Part III New Species of Cicadidae and Fulgoridae from India and Burma (Hemip) by O C Ollenbach, Part iv A new Subgenus and Species of Tingis from Burma (Tingitidae, Hemip) by Carl J Drake Part v New Thysanoptera from India by Dudley Moulton Pp. iii+48+5 tafeln+2+12+1 plate+2+8 (Calcutta Government of India Central Publication Branch) 1 6 rupees 2s 3d

Department of the Interior Canada Topographical Survey Bulletin No 60 A Study of the Dominion Standard Yard and other Standards of Length By R H Field Pp. 40 (Ottawa F A Acland)

Rhodesia Museum Bulawayo. Twenty seventh Annual Report 1928 Pp. 14 (Bulawayo)

FOREIGN

The Science Reports of the Tôhoku Imperial University, Sendai Japan Fourth Series (Biology), Vol 4, No 1, Fasc 1 Pp. 183+11 plates (Tokyo and Sendai Maruzen Co. Ltd)

Journal of the Faculty of Science Imperial University of Kyoto Section 4 Zoology Vol 1 Part 5 Studies on the Calcareous Sponges of Japan By Prof Sanji Hozawa. Pp. 277 389+plates 12 23 (Tokyo Maruzen Co., Ltd) 8 00 yen

Scientific Papers of the Institute of Physical and Chemical Research No 177 Experimental Studies on Form and Structure of Sparks Part 5 By Torahiko Terada, Ukitirô Nakaya and Ryûzô Yamamoto. Pp 43 68+18 plates 70 sen No 178 Katalizeca malkombiniĝo de karbono unuoksido. 1 Fero kiel katalizanto De Hirosi Tutiya. Pp 69 82+plate 19 90 sen No 179 Untersuchung der Dekahydrochinolinderivate. 5 Mitteilung Synthese des trans-o-Dimethylamido n propyl cyclohexans und die Wasserspaltung des o-n Propyl-cyclohexanols. Von Shin ichiro Fujise Pp 83-89 20 sen No 180 Physico-chemical Studies on Bioluminescence 7 The Solubility of Cypridina Luciferin in Organic Solvents. By Sakyo Kanda. Pp. 91 98. 15 sen No 181 Stark Effect of Helium 2P 6D line by Quantum Mechanics. By Yoshio Fujioka Pp. 99-106+plate 20 25 sen (Tôkyô Iwanami Shoten)

Department of Commerce Bureau of Fisheries Bureau of Fisheries Document, No 1045 The Public Aquarium its Construction, Equipment and Management. By Charles Haskins Townsend (Appendix 7 to the Report of the U S Commissioner of Fisheries for 1928) Pp. 249-337 (Washington D C Government Printing Office) 25 cents

United States Department of Agriculture Technical Bulletin No 77 The Host Plants of the European Corn Borer in New England By Benjamin E Hodgson. Pp. 64. (Washington D C Government Printing Office.) 30 cents.

Observations and Investigations made at the Blue Hill Meteorological Observatory in the Year 1928 under the direction of Prof Alexander McAdie. Pp. 29+36 plates. (Cambridge, Mass)

University of California Publications in American Archaeology and Ethnology Vol 25 No 2 Mentawei Religious Cult By Edwin M Loeb Pp 185-247+plates 69-73 80 cents. Vol 25 No 3 Tribal Initiations and Secret Societies By Edwin M Loeb Pp. 249-288 50 cents. (Berkeley Calif University of California Press London Cambridge University Press)

Deutsche Seewarte Aus dem Archiv der Deutschen Seewarte Band 46 Nr 3 Gezeitenuntersuchungen in der Deutschen Bucht der Nordsee Nach Beobachtungen an Bord des Vermessungsschiffes *Panther* im Juni 1924 Im Auftrage der Deutschen Seewarte bearbeitet von Dr H Thorade Pp 85+4 Tafeln (Hamburg)

Department of Commerce Bureau of Standards Research Paper No 45 Apparatus and Methods for the Separation Identification and Determination of the Chemical Constituents of Petroleum By Edward W Washburn Johannes H Bruun and Mildred M Hicks Pp. 467-488+5 plates 10 cents Research Paper No 46 Recombination Spectra of Ions and Electrons in Caesium and Helium By F L Mohler and C Boeckner Pp. 489-500 5 cents Research Paper No 49 Discharge Coefficients of Square-edged Orifices for Measuring the Flow of Air By H S Bean E Buckingham and P S Murphy Pp 561-658+2 plates 20 cents (Washington D C Government Printing Office)

Proceedings of the United States National Museum Vol 74 Art 13 Tschermigite Ammoniojarosite Epsomite Celestite and Paligorskite from Southern Utah By Earl V Shannon. (No 2758) Pp. 12. Vol 74 Art 15 The Fossil Crinoid Genus *Vasocrinus* Lyon By Edwin Kirk (No 2760) Pp 16+2 plates. Vol 74 Art 21 Miargyrite Silver Ore from the Randsburg District California By Earl V Shannon (No 2766) Pp 10 Vol 74 Art 24 Notes and New Species of American Moths of the Genus Scoparia Haworth By Harrison G Dyar (No 2769) Pp 9 Vol 74 Art. 25 A New Salamander from Southern California. By Emmett Reid Dunn (No 2770) Pp 3 (Washington D C Government Printing Office)

Diary of Societies

FRIDAY April 19

Physical Society (at Imperial College of Science) at 5 —Presentation of the Guthrie Medal to Dr C E Guillaume —Prof W R Bridgman The Properties of the Elements under High Pressures (Guthrie Lecture)

British Institute of Radiology (Medical) at 5 —Informal Discussion on Bone Diseases (especially Multiple Myeloma).

Institution of Mechanical Engineers, at 6 —W Reavell The Standardisation of Keys and Keyways

Institution of Electrical Engineers (London Students Section) (Annual General Meeting), at 6 15 —V E Connor The Manufacturing and Testing of Submarine Cables

Royal Photographic Society of Great Britain at 7 —B Chambers and F W Sharp Carbon and Carbro

Society of Dyers and Colourists (Glasgow Section) (at 7 Gordon Street, Glasgow) at 7 15 —Annual General Meeting

West Bromwich Engineering Society (at Kenrick Technical College West Bromwich) at 7 30 —D G Mackintosh The Erection of Steel Bridges

Junior Institution of Engineers at 7 30 —Lt Col J T C Moore Brabazon Early Aviation (Lecture).

Institute of British Foundrymen (Sheffield Branch) (Annual Meeting) (at Albany Hotel Sheffield) at 7 45 —Recent Developments in Cupola Control

Royal Society of Medicine (Electro Therapeutics Section) at 8 30 —Dr S G Scott Myeloma—Differential Diagnosis —Dr J D White Bone Lesions in Tropical Diseases

Royal Institution of Great Britain, at 9 —Prof Owen T Jones History of the Grand Canyon Yellowstone National Park

Society of Dyers and Colourists (Manchester Section) (at Manchester). —Annual General Meeting

SATURDAY April 20

Institution of Municipal and County Engineers (Southern District) (at Council House Bristol) at 10 30 a m —H F Proctor Description of the New Power Station Portishead

North of England Institute of Mining and Mechanical Engineers (Newcastle upon Tyne) at 2 30 —C H Leeds Boring against Workings likely to contain an Accumulation of Water or other Liquid Matter and a Method of Negotiating a Fault —C N Kemp The X Ray Analysis of Coal the Radiographic Variables and their Control —Papers open for discussion —Roof Control on Longwall Faces J F C Friend Diamond Boring Applied to Tapping Drowned Areas Underground F F Smyth Land Drainage H C Pawson The Laws of Motion of Particles in a Fluid R. G Lunnon

Mining Institute of Scotland (at Royal Technical College Glasgow).—Annual Meeting

MONDAY April 22

Royal Geographical Society (at Lowther Lodge), at 4 —Miss E R G Taylor Roger Barlow an Early XVIth Century Geographer

Victoria Institute at 4 30 —Dr A. T Schofield Humanity

Institution of Mechanical Engineers (Graduates Section London), at 6.30 —Informal Discussion on The Engineer as a Salesman

Institution of Automobile Engineers (Graduates Meeting) (at Loughborough College), at 7 —H M Smith Steering Gears

Institution of Automobile Engineers (North of England Centre) (at Sheffield University) at 7 —Dr H J Gough Recent Developments in the Study of the Fatigue of Metals

Royal Photographic Society of Great Britain (Informal Meeting of Kinematograph Group) at 7 —H A Carter The De Vry 16 mm Synchronised Sound Motion Picture Apparatus with Projection of Films and Synchronised Gramophone Records.

Royal Institute of British Architects at 8 —J Begg The Work of George Wittet

Royal Society of Arts, at 8 —Sir E Denison Ross Nomadic Movements in Asia (Cantor Lectures) (II).

Royal Society of Medicine (Odontology Section), at 8 —G Northcroft The Migration of a Foreign Body —S Friel The Relation of Function to the Size and Form of the Jaws.

Royal Geographical Society (at Polytechnic, Regent Street), at 8 30 —G M Dyott The Search for Col Fawcett (with Kinematograph Films)

TUESDAY, April 23

Royal Society of Medicine (Medicine Section), at 5 —Dr O Leyton How can we decide whether a case of Glycosuria should be treated?—Dr W T Munro Pulmonary Tuberculosis due to Bovine Tubercle Bacilli

Zoological Society of London at 5.30 —Secretary (a) Report on the Additions to the Society's Menagerie during the month of March 1929 (b) Exhibition and Note on the Society's Scientific Publications.—S G M Ramanujam The Study of the Development of the Vertebral Column in Teleosts as shown in the Life history of the Herring —Prof E B Poulton British Insectivorous Bats and their Prey

Institution of Civil Engineers at 6.

London Natural History Society (at Winchester House E C) (Bacot Memorial Meeting) at 6 30 —R S Bagnall Plants and their Insect Associates

Royal Photographic Society of Great Britain at 7 —H R Ward Some Continental Zoos

Institution of Automobile Engineers (Wolverhampton Centre) (at Engineering and Scientific Club Wolverhampton), at 7 30 —H W Pitt Central Lubrication of Chassis Bearings

WEDNESDAY April 24

Eugenics Society (at Royal Society) at 5 15 —C J Bond Bilateral Asymmetry in Animals and Man and its Relation to Cross breeding (Lecture)

Newcomen Society for the Study of the History of Engineering and Technology (at Caxton Hall), at 5 30 —C F Dendy Marshall The Rainhill Locomotive Trials of 1829

Geological Society of London at 5 30 —R. Murray Hughes The Geology of Part of North Western Rhodesia with Petrographical Notes by A A Fitch

Royal Society of Arts, at 8 —Lynton Fletcher Recent Developments in Educational Broadcasting

THURSDAY April 25

London Mathematical Society (at Royal Astronomical Society) at 5 —S D Chowla Some Formulae Connected with Gauss's Sums —Doris M Hirst On Expansions which are Formally Reduced to Zero by the Operator Sinh $D-cD$ —Prof E W Hobson On a Generalisation of Watson's Expressions for Legendre's Functions —Prof R. L Jeffery The Continuity of a Function Defined by a Definite Integral —J Tennant Nasik or Pandiagonal Squares of the Order of any Odd Prime

Institute of Pathology and Research (St. Mary's Hospital W 2) at 5 —Sir Almroth E Wright The Experimental Method in Medicine

Chemical Society (at Institution of Mechanical Engineers) at 5 30 —Sir Harold Hartley Theodore W Richards Memorial Lecture.

Royal Society of Medicine (Urology Section), at 5 30 —Dr P J Cammidge Prostatectomy in Diabetics

Institution of Electrical Engineers, at 6 —Dr G C Simpson Lightning (Kelvin Lecture)

Royal Aeronautical Society (at Royal Society of Arts), at 6 30 —Squadron Leader C L Scott By Flying Boat to India.

FRIDAY, April 26

Physical Society (at Imperial College of Science), at 5 —T Smith Dr C F C Searle Instructor Capt T Y Baker Dr J W French W E Williams O G Vernon H H Emsley C W Hansel H Tunley J Moore Conrad Beck, V T Saunders and Dr C V Drysdale Discussion on The Teaching of Geometrical Optics

Royal Society of Medicine (Disease in Children Section) at 5

Royal Institution of Great Britain at 7 —E A Salt Platinotype

Institution of Electrical Engineers (Scottish Centre) (at University College Dundee) at 7 30 —W Holmes Load levelling Relays and their Application in connexion with Future Metering Problems

Royal Society of Medicine (Epidemiology Section) at 8 —Dr J G Thomson Endemic Malaria in Southern Rhodesia.

British Psychological Society (Industrial Section) (at National Institute of Industrial Psychology), at 8 —J N Langdon Evidence of a Central Factor in Tests of Manual Dexterity

Royal Institution of Great Britain at 9 —Prof R. W Chambers English Civilisation from Alfred to Harold 900–1066

PUBLIC LECTURES

MONDAY April 22

The University Glasgow at 5 —Sir Norman Walker Medical Education and Qualification in the United States

TUESDAY April 23

Gresham College (Basinghall Street) at 6 —A. R. Hinks Latitudes and Longitudes (Gresham Lectures). (Succeeding Lectures on April 24 25, and 26)

Institution of Mechanical Engineers, at 8 —C E Stromeyer What Health and Civilisation owe to Engineering (Chadwick Lecture)

WEDNESDAY, April 24

University of Birmingham at 4.30 —Dr C Singer Epochs of Medical History (Succeeding Lectures on May 1 and 8, June 19 and 26)

Mansion House (arranged by British Science Guild), at 4.30.—Developments of British Chemical Manufactures. Lord Melchett in the chair —Sir Frederick Keeble Fertilisers from the Air —A B. Shearer Rayon (Artificial Silk) —F H Carr Synthetic Drugs

FRIDAY, April 26.

World Association for Adult Education (16 Russell Square, W C 1), at 8 30 —Miss R M Fleming Soil and Civilisation in Russia.

SATURDAY, APRIL 27, 1929

CONTENTS

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No 3104, Vol 123]

The Smithsonian Institution and Scientific Education

SINCE the last Report of the Smithsonian Institution was published, a new secretary, Dr Charles G Abbot, Director of the Astrophysical Observatory, has been appointed, and the Report to June 30, 1928, appears over his signature It is impossible in these columns to mention, far less to do justice to, the manifold activities of this wonder ful institution, with its great museums of science and of art, its zoological park, its astronomical observatory and its international exchange service But the new secretary, in virtue of his appoint ment has felt it to be his duty to make a wide survey of the activities of the Smithsonian," in order to gain some knowledge of the most effective ways in which it may advance the mission of its founder, James Smithson, for the increase and diffusion of knowledge amongst men '

Dr Abbot s conclusions are of great interest, and since they are of general application, deserve wide attention He points out that, to the casual observer, it may appear that the most important function of the Smithsonian is the administration of the national museum, art galleries, and zoological park confided to its direction The educational value of these is great, but a closer analysis would show that their influence is largely confined to the neighbouring States, and that a lessening of influence, which increases rapidly with distance, affects more distant States and foreign countries

On the other hand, to be contrasted with this relatively local influence, is the wider reach of the International Exchange Service, as associated with the publications of the Institution Reviewing the whole field, Dr Abbot is led to the conclusion that the care of the public exhibits, educational and interesting though they are, is after all not the greatest duty of the Smithsonian Institution In his view its main services to science are

In the collection of new specimens, which the passage of a few more years might prevent for ever , in the study of existing national collections to unlock the treasures of knowledge which they certainly contain , in the promotion of researches growing out of our expert experience in the field of radiation , in the publication of knowledge in both technical and popular forms , and in the wide diffusion of knowledge through exchanges and correspondence in all these lines, activities entirely suited to the genius and situation of the Smith sonian, which in their world wide application and future promise, outrank in value the more local influence of the public exhibitions "

The one thing that is lacking to promote these

researches on the scale they deserve is, the impecunious institutes of Britain will learn with a shock of sympathy, lack of adequate means

Put broadly, Dr Abbot's view rather sounds like pitting against one another the advance of technical knowledge and the scientific education of the people, the latter of which is bound in the end to be more local in its development, since the less educated a person may be the more he must depend on sense impressions and the less on the mental stimulus of the written word, and the Smithsonian plumps heavily for the former Now we are not convinced that the contrast is a necessary one, since if both the scientific education of the people and the advance of technical scientific knowledge are essential, it can scarcely be said that one is of more value than the other Both are necessary ingredients in the sum of scientific advancement

If science is to make the progress it deserves, it must be upon the basis of a wide sympathy and understanding amongst the plain men of the earth At the lowest terms of this compact, research can obtain the adequate funds which the Smithsonian and every other scientific institution longs for, only when the public has grasped the vital importance of scientific results so thoroughly that it compels the disbursement for such purposes of the State funds which it itself contributes In other words, in these democratic days, the adequate prosecution of research is inextricably bound up with the scientific education of the people

Science and Humanism

The neglect of science by historians, and the misunderstanding of its service by representatives of labour, are familiar to most readers of Nature The new review *The Realist*, to which reference was made in our issue of April 6, p 540, contains two contributions dealing respectively with these subjects—one by Dr Singer on scientific humanism and the other by Mr John Gibson on the relations of labour and science Both describe from different points of view a state of things which our readers would wish to alter both resolve themselves ultimately into a question of education

Dr Singer starts with the astounding fact, often commented on in these columns, that our accustomed books on history, even such monumental works as the "Cambridge Modern History," ignore, for the most part completely, the rôle played by science in the historic process As he says—and it is a new way of putting it—"Had it so fallen out that Galileo and Kepler, Newton and Lavoisier and Darwin had been Persians, Turks, Indians, and Russians instead of Italians, Germans, Frenchmen, and Englishmen, it is very certain that the face of the civilised world would have been quite different from what it is Yet such names are wellnigh ignored in ordinary works of history" The 'ordinary' historian, when charged with this, says either that history is past politics, or how men have come to live together more or less peacefully in States, or, if he does not subscribe to this narrow and exploded heresy, that he does not know about science and thinks it better to leave it to those who do The latter argument, however, is not applicable to such a work as the "Cambridge Modern History," which is a composite production and might just as well contain chapters on science as it does certain chapters on literature

The right solution is one which will take years of philosophic thinking to achieve, namely, what is the place which science has taken in building up the social structure which is, as most of the historians now perceive, the proper subject of history Dr Singer therefore seems to us perfectly right in laying more stress on the introduction of science in its proper place in the presentation of general history than on the elaboration of the historic side in the teaching of science, though that also is a good thing

The article by Mr Gibson, on science and labour, is more depressing and raises another educational question of a wider kind Mr Gibson notes the almost complete absence of any knowledge or interest in science among the workmen whom he has met, and also finds dread and opposition to the spread of machinery as displacing the human worker He is probably generalising from the class of workmen—those in the building trades—who suffer most immediately from the introduction of new machines and have the least turn for mechanics The picture would not be so black if it were painted of any branch of the engineers So far as the educational question is concerned, it should be easier rather than more difficult to imbue the young workman with some knowledge and interest in science than his more lettered fellow scholar who gives so much time to literature and the study of the dead languages The boy who goes to a technical or a central school with an industrial bias—and these places are growing—has a good opportunity of approaching science at least on the practical side, and Mr Gibson's account of the young man of to-day who does all

the needed repairs to his motor bicycle or his wireless set, inspires one with some hope It is, of course, precisely by that channel that the intelligent teacher of science will approach the theoretical basis

On the question of the displacement of the man by the machine, Mr Gibson is dealing with a problem of social and economic organisation which has been with us all through the Industrial Revolution It cannot be said that we have dealt with it very wisely or successfully, and yet we are all agreed that operations which can be as efficiently performed by a machine should, in the interest alike of production and the producer, be so done Every displacement however, should be accompanied by careful provision for the displaced The social *raison d'être* of the machine is that it frees the human agent for other work, either in the further conquest of Nature or the development of his own faculties

Srinivasa Ramanujan

Collected Papers of Srinivasa Ramanujan Edited by G H Hardy, P V Seshu Aiyar and B M Wilson Pp xxxvi + 355 (Cambridge At the University Press, 1927) 30*s* net

RAMANUJAN was born in India in December 1887, came to Trinity College, Cambridge, in April 1914, was ill from May 1917 onwards, returned to India in February 1919, and died in April 1920 He was a fellow of Trinity and a fellow of the Royal Society

Ramanujan had no university education, and worked unaided in India until he was twenty seven years of age When he was sixteen he came by chance upon a copy of Carr's " Synopsis of Mathematics ", and this book, now sure of an immortality its author can scarcely have dreamt of, woke him quite suddenly to full activity A study of its contents is indispensable to any considered verdict upon Ramanujan It gives a very full account of the purely formal side of the integral calculus, containing, for example, Parseval's formula, Fourier's repeated integral, and other ' inversion formulæ ' There is also a section on the transformation of power series into continued fractions Ramanujan somehow acquired also an effectively complete knowledge of the formal side of the theory of elliptic functions (not in Carr) The matter is obscure, but this, together with what is to be found in, say, Chrystal's " Algebra ", seems to have been his complete equipment in analysis and theory of numbers It is at least certain that he knew nothing of operations with divergent series or of work on the distribution of primes Above all, he was totally ignorant of Cauchy's theorem and complex function theory

The work he published during his Indian period did not represent his best ideas, which he was probably unable to expound to the satisfaction of editors In the beginning of 1914, however, a letter from Ramanujan to Mr Hardy (then at Trinity, Cambridge) gave unmistakable evidence of his powers, and he was brought to Trinity, where he had three years of health and activity

I do not propose to discuss here in detail the work for which Ramanujan is solely responsible (a very interesting estimate is given by Prof Hardy, p xxxiv) If we leave out of account for the moment a famous paper written in collaboration with Hardy, his definite contributions to mathematics, substantial and original as they are, must, I think, take second place in general interest to the romance of his life and mathematical career, his unusual psychology, and, above all to the fascinating problem of how great a mathematician he might have become in more fortunate circumstances In saying this, of course, I am adopting the highest possible standard but no other is appropriate

Ramanujan s great gift is a formal one, he dealt in ' formulæ ' As a specimen we may take the following (which no one can ever resist quoting) If $p(n)$ is the number of ways of expressing n as a sum of positive integers (partitions of n ') then

$$p(4)+p(9)x+p(14)x^2+p(19)x^3+\dots = 5\frac{\{(1-x^5)(1-x^{10})(1-x^{15})\dots\}^5}{\{(1-x)(1-x^2)(1-x^3)\dots\}^6}$$

The great day of formulæ however, is over No one, if we are again to take the highest point of view, seems able to discover a radically new type, though Ramanujan comes near it in his work on partition series A hundred years or so ago his powers would have had ample scope Discoveries alter the general mathematical atmosphere and have very remote effects, and we are not prone to attach great weight to rediscoveries, however independent they seem How much are we to allow for this , how great a mathematician might Ramanujan have been 100 or 150 years ago , what would have happened if he had come into touch with Euler at the right moment ? How much does lack of education matter ? Was it formulæ or nothing, or did he develop in the direction he did only because of Carr's book—after all, he learned later to do new things well, and at an age mature for an

Indian? Such are the problems Ramanujan raises; and everyone has now the material to judge them. The letters and the lists of results announced without proof are the most valuable evidence; indeed, they suggest that the 'note-books' would give an even more definite picture of the essential Ramanujan, and it is very much to be hoped that the editor's project of publishing them *in extenso* will eventually be carried out.

Carr's book quite plainly gave Ramanujan both a general direction and the germs of many of his most elaborate developments. But even with these partly derivative results one is impressed by his extraordinary profusion, variety, and power. There is scarcely a field of formulæ that he has not enriched, and in which he has not revealed unsuspected possibilities. The beauty and singularity of his results are entirely uncanny. Are they odder than one would expect things selected for oddity to be? The moral seems to be that we never expect enough; the reader at any rate experiences perpetual shocks of delighted surprise. Prof. Watson and Mr. Preece have begun the heroic task of working through the unproved statements; some of their solutions have appeared recently in the *Journal of the London Mathematical Society*, and these strongly encourage the opinion that a complete analysis of his note books will prove very well worth while.

There can, however, be little doubt that the results showing the most unmistakable originality and the deepest insight are those on the distribution of primes (see pp. xxii-xxv, xxvii, 351, 352). The problems here are not in origin formal at all; they concern approximative formulæ for such things as the number of primes, or of integers expressible as the sum of two squares, less than a large number x, and the determination of the order of the errors is a major part of the theory. The subject has a subtle function theory side; it was inevitable that Ramanujan should fail here, and that his methods should lead him astray; he predicts the approximative formulæ, but is quite wrong about the orders of the errors. These problems tax the last resources of analysis, took more than a hundred years to solve, and were not solved at all before 1890; Ramanujan could not possibly have achieved complete success. What he did was to perceive that an attack on the problems could at least be begun on the formal side, and to reach a point at which the main results became plausible. The formulæ do not in the least lie on the surface, and his achievement, taken as a whole, is quite extraordinary.

If Carr's book gave Ramanujan direction, it had at least nothing to do with his *methods*, the most important of which were completely original. His intuition worked in analogies, sometimes very remote, and to an astonishing extent by empirical induction from particular numerical cases. Lacking Cauchy's theorem, he naturally dealt much in transformations and inversions of order of double integrals. But his most important weapon seems to have been a highly elaborate technique of transformation by means of divergent series and integrals. He had no strict logical justification for his operations. He was not interested in rigour, which for that matter is of secondary importance in analysis, and can be supplied, given the real idea, by any competent professional. The clear cut idea of what is *meant* by a proof, nowadays so familiar as to be taken for granted, he perhaps did not possess at all. If a significant piece of reasoning occurred somewhere, and the total mixture of evidence and intuition gave him certainty, he looked no further. It is a minor indication of his quality that he can never have *missed* Cauchy's theorem. With it he would have arrived more rapidly and conveniently at some of his results, but his own methods enabled him to survey the field with an equal comprehensiveness and as sure a grasp.

I must say something finally of the paper on partitions (pp. 276-309), written jointly with Hardy. The number $p(n)$ of partitions of n increases rapidly with n; thus

$$p(200) = 3972999029388.$$

The authors show that $p(n)$ is the integer nearest to

$$\text{(1)} \qquad \frac{1}{2\sqrt{2}} \sum_{q=1}^{\nu} \sqrt{q}\, A_q(n) \psi_q(n),$$

where $A_q(n) = \sum \omega_{p,q} e^{-2np\pi i/q}$, the sum being over p's prime to q and less than it, $\omega_{p,q}$ is a certain $24q^{\text{th}}$ root of unity, ν is of the order of $\sqrt{n}$, and

$$\psi_q(n) = \frac{d}{dn}\left(\exp\{C\sqrt{(n - \tfrac{1}{24})}/q\}\right), \quad C = \pi\sqrt{(\tfrac{2}{3})}.$$

We may take $\nu = 4$ when $n = 100$. For $n = 200$ we may take $\nu = 5$; five terms of the series (1) predict the correct value of $p(200)$. We may always take $\nu = \alpha\sqrt{n}$ (or rather the nearest integer), where α is any positive constant, provided n exceeds a value $n_0(\alpha)$ depending only on α.

The reader does not need to be told that this is a very astonishing theorem, and he will readily believe that the methods by which it was established involve a new and important principle, which has been found very powerful and fruitful in other fields. The story of the theorem is a romantic one. (To do justice to it I must infringe a little the rules

about collaborations I therefore add that Prof Hardy confirms and permits my statements of bare fact) One of Ramanujan's Indian con jectures was that the first term of (1) was a very good approximation to $p(n)$ this was established without great difficulty At this stage the $n-\frac{1}{24}$ was represented by a plain n—the distinction is irrelevant From this point the real attack begins The next step in development, not a very great one, was to treat (1) as an asymptotic ' series, of which a fixed number of terms (e g $\nu=4$) were to be taken, with an error of the order of the next term

From now to the very end Ramanujan always insisted that much more was true than had yet been established there must be a formula with error $O(1)$ " This was his most important con tribution , it was both absolutely essential and most extraordinary A severe numerical test was now made, which elicited the astonishing facts about $p(100)$ and $p(200)$ Then ν was made a function of n this *was* a very great step, and in volved new and deep function theory methods that Ramanujan obviously could not have discovered by himself The complete theorem thus emerged

The solution of the final difficulty was probably impossible, however, without one more contribution from Ramanujan, this time a perfectly characteristic one As if its analytical difficulties were not enough the theorem was entrenched also behind almost im pregnable defences of a purely formal kind The form of the function $\psi_q(n)$ is a kind of indivisible unit among many asymptotically equivalent forms it is essential to select exactly the right one Unless this is done at the outset, and the $-\frac{1}{24}$ (to say nothing of the d/dn) is an extraordinary stroke of formal genius, the complete result can never come into the picture at all There is indeed, more than a touch of real mystery If only we *knew* there was a formula with error $O(1)$, we might be forced to the correct form of ψ_q But why was Ramanujan so certain there was one ? *Theoretical* insight, to be the explanation, had to be of an order scarcely to be credited Yet it is hard to see what numerical instances could have been available to suggest so strong a result and unless the form of ψ_q were known already, *no* numerical evidence could suggest anything of the kind—there seems no escape, at least, from the conclusion that the discovery of the correct form was a single stroke of insight We owe the theorem to a singularly happy collaboration of two men, of quite unlike gifts, in which each contributed the best, most characteristic, and most fortunate work that was in him Ramanujan's genius did have this one opportunity worthy of it

The volume contains a biography by the second of the editors, and the obituary notice by Prof Hardy These give a vivid picture of Ramanujan's interesting and attractive personality The mathe matical editors have done their work most admirably It is very unobtrusive the reader is told what he wants to know at exactly the right moment and more thought and bibliographical research must have gone into it than he is likely to suspect J E LITTLEWOOD

Filterable Viruses

Filterable Viruses By Harold L Amoss, Jacques J Bronfenbrenner, Alexis Carrel, Edmund V Cowdry, Rudolf W Glaser, Ernest W Good pasture, Louis O Kunkel, Stuart Mudd, Peter K Olitsky, Thomas M Rivers Edited by Thomas M Rivers Pp ix+428+15 plates (London Baillière, Tindall and Cox, 1928) 34s net

THE nature of virus still eludes precise de finition No one knows exactly what it is, and none of the hypotheses covers all the apparent facts without a certain amount of artificial strain ing At one extreme there is the conception that a virus is a parasite, something analogous in a general way, though not necessarily closely similar to a bacterium or a protozoon, with properties appropriate to its very small size It is odd, though, if this is so, that no saprophytic virus is known We can imagine a pathogenic bacterium arising by some process of adaptation from the many similar saprophytes existing everywhere in Nature, but the viruses are always associated with living cells and have never been certainly known to multiply in their absence At the other extreme are those who look upon them as derivatives of the cells with which they are associated, possibly par ticulate but not living individual organisms The difficulty in this view is to explain the transmissi bility, the remarkable power of multiplication or increase, and the specificity revealed by serological reactions

Midway between these extremes come those who, like Boycott, regard viruses as an order of being neither wholly alive nor wholly dead, but with some of the properties of both states or, like Wollman, look upon them as altered detachable genes, capable of leaving their cells of origin and entering other similar cells, an intriguing combination of infection and heredity The parasitic conception, however, is a convenient working hypothesis Nothing certainly disproves it, and it will probably

continue to hold the field until there is conclusive evidence of the origin of a virus *de novo*, as is already suggested by the work on bacteriophage and the filterable tumours

Animal pathologists lay great stress on filterability as an important character, and so no doubt it is when it occurs But its present importance is perhaps chiefly a historical residue Even in animal virus diseases it is not a constant character, and the plant pathologist attaches little importance to it, even in diagnosis, since most of the virus diseases of plants are not transmissible by extracted juice, whether filtered or not It is possible that it may come to have a real importance as a means of distinguishing viruses which can be detached from their cells without loss of character from those which cannot, but this is still in the future One is glad to see that in the book under review the term 'filterable viruses' is used in a general non committal way to cover all the active transmissible agents which produce virus disease

The present volume is sure of a welcome, and deserves it The amount of information that has accumulated on the subject of virus diseases since Iwanowski showed, thirty seven years ago, that tobacco mosaic is filterable, is so enormous that even the specialist cannot keep abreast of it all It covers so wide a field (mammals, birds, fish, plants, insects, even bacteria) and the literature is so widely scattered that it is difficult so much as to hear of all the papers that appear, and the collection of the salient facts into a single volume is a useful piece of work Even in this volume of more than 400 pages, detailed survey has proved impracticable, and the method adopted is to select certain diseases of man, animals, fowls, etc , and treat them as typical examples of the different groups, prefacing them with some chapters of a more general nature

The first chapter, on "Some General Aspects of Filterable Viruses," by the general editor, T M Rivers, has already appeared in the *Journal of Bacteriology* It discusses in a series of short sections such questions as epidemiology, immunity, filterability, size and the like, giving briefly the ascertained facts and occasionally the theories This chapter, we think, might have been considerably expanded The book, as a whole, no doubt aims mainly, and commendably, at recapitulating established fact rather than theoretical discussion, but—to take only one example—to abandon a consideration of whether viruses are animate or inanimate, on the ground that "it leads one into the sterile discussion of what life is, a problem still in the realm of metaphysics," seems scarcely adequate

An excellent chapter follows on filters and filtration, by Stuart Mudd, practical and sane, and also salutary because many unwarranted conclusions have been drawn from experiments with filters The third chapter is by A Carrel, on tissue culture, in the study of viruses, a method likely to lead to greater results than it has produced as yet E V Cowdry contributes a cautious, well balanced, and informative discussion on intracellular pathology, with excellent illustrations, coloured and uncoloured

Then follow the special articles already referred to Poliomyelitis in man by H L Amoss, foot and mouth and vesicular stomatitis by P K Olitsky, contagious epithelioma in birds by E W Goodpasture, virus diseases of insects by R W Glaser, of plants by L O Kunkel, and of bacteria by J J Bronfenbrenner All these are authorities on the subjects of which they treat, and, although in every case a specialist will no doubt wonder at some omissions and feel disposed to quarrel with some statements made, still they do give excellent reviews of present knowledge and convenient summaries of present opinion, and that is what one hopes to find in chapters such as these They are addressed not so much to the specialist, who presumably knows the facts of his own subject, as to the semi specialist and the worker on cognate lines, who cannot easily keep in touch with current knowledge outside his own limited field This function they serve admirably The whole volume is a most useful and convenient collection of the available information on filterable viruses

J HENDERSON SMITH

Problems of Island Life

Diptera Brachycera and Athericera of the Fiji Islands based on Material in the British Museum (Natural History) By Mario Bezzi Pp viii + 220 (London British Museum (Natural History), 1928) 15s

ISLAND life presents problems of great interest to the biologist and in particular to the student of geographical distribution Among the many islands of Polynesia a great field for research awaits inquiry In so far as the insects and other invertebrates are concerned, we know as yet comparatively little respecting what peculiar forms are present, how the creatures of one group of islands differ from those of another, and from where they have been derived

The Hawaiian group is better known than any other Pacific archipelago, a fact largely due to the wisdom and foresight of those Englishmen who inaugurated the "Fauna Hawaiiensis" and saw it through to completion Its volumes form the groundwork for all subsequent progress in Hawaiian entomology, besides providing an important contribution to the problems of island life in general The work was not instituted one month too soon —in fact, species had already disappeared and become lost to science before its inception To day the spread of cultivation on the island of Oahu, for example, has practically destroyed the whole of the indigenous insect fauna over most of the terrain—what is left is mainly to be found on the forest-clad flanks of its steep mountains Without the "Fauna Hawaiiensis" we should be at a loss to day to know whether many of the insects are introduced or indigenous, and when it comes to problems of pest control this knowledge acquires added importance The work of the Percy Sladen Trust Expedition, under Prof J Stanley Gardiner, has similarly laid the foundations of our knowledge of the fauna of the Seychelles and neighbouring islands in the Indian Ocean

It is only a matter of time when Fiji Samoa, and all the larger oceanic islands will inevitably come under the influence of cultivation to the same extent as the Hawaiian group To day they are changing, and new elements are entering their fauna through the agency of increased maritime communications Sooner or later a highly composite and drastically altered fauna will result There is no doubt, therefore, if we are to have an adequate knowledge respecting the native insects and other elements of the fauna of Polynesia, every opportunity needs to be utilised, at least to collect material, before civilisation advances much further It might be feasible to circularise and impress this fact upon all resident naturalists and induce them to send specimens to our national collection It may be necessary to provide them with instructions store boxes and apparatus, but it would be worth while and the costs would be relatively trifling

The small volume by the late Prof Bezzi, now before us, consists of a series of highly technical detailed descriptions of flies from the Fiji Islands Since its author was one of the most eminent of Dipterists, it is consequently authoritative Altogether 239 species of flies are dealt with, and it is noteworthy that only 30 of them were known to exist in Fiji (including the Tonga Islands) up to the end of the year 1925 It is also interesting to note that 60 per cent of the flies enumerated are endemic to Fiji, and nearly all were previously undescribed Certain families of flies, notably the Ortalidæ, Trypetidæ, Chloropidæ, and Muscidæ, comprise, on the other hand, a good many non endemic forms, probably on account of their association with the activities of man Their distribution by commerce in fruits and other vegetable matter, or by the drifting of trees and plant debris in the sea, accounts for the presence of a considerable number Excluding the imported elements, the Fijian dipterous fauna is an endemic one of Austro Malayan origin A point of great economic importance is the fact that the Mediterranean fruit fly (*Ceratitis capitata*) is happily absent from the list, and yet it is a pest in some other Pacific islands

The Natural History Museum has done zoology a service in publishing this volume, and it is to be hoped that its appearance will stimulate the collection of further material bearing upon the unique problems of island life A D IMMS

Methods of Sea-water Biology

Handbuch der biologischen Arbeitsmethoden Herausgegeben von Prof Dr Emil Abderhalden Lieferung 256 Abt 9 *Methoden der Erforschung der Leistungen des tierischen Organismus*, Teil 5, Heft 2 *Methoden der Meerwasserbiologie* Über Kultur und Methodik beim Studium der Meerespflanzen, von Josef Schiller, Methoden der Untersuchung der Bodenfauna des Meerwassers, von Harald Blegvad Pp 181 330 +11 Tafeln (Berlin und Wien Urban und Schwarzenberg, 1928) 10 gold marks

SCHILLER'S work occupies 129 pages of this part of Abderhalden's "Handbuch," the remaining 20 with 11 tables being Blegvad's portion The former contains detailed information on the setting up of small aquaria, their aeration and temperature control Some account is given of the chemical composition of sea water and of the various salt solutions used for the culture of fresh water and marine algae, sections are devoted to the organic nutrients useful in the study of marine Chrysoand Cryptomonads and other plants, also to solid media and colloidal solutions Attention is directed to the necessity of regulating the intensity of the light, and details are given concerning the construction of various types of light filter, solid and liquid References are made in particular to Pringsheim's work on the culture of algæ, mention is made of Schott und Gen's light filters,

but the Wratten and Corning filters have been omitted

Throughout, one is struck with the fewness of the references to British and American work—but then British marine biology has been preponderatingly zoological, and Oltmanns remains the standard authority on the marine flora of a sea going nation The Americans, though active on the Pacific coast, have been late comers into this field A section is devoted to the isolation of organisms required for pure cultures and there is a figure of a pipette, with rubber teat, of quite unserviceable thinness, the centrifuge tube shown would break at the first time of using Simple forms of water sample bottles are shown, but the standard Nansen Petersen is not mentioned

The purely botanical portion is done with Teutonic thoroughness, the groups being considered one by one in great detail The reviewer confesses to a feeling of surprise at reading of the large number of algæ that have been cultivated Mention is made of Thuret's early (1854) work on the crossing of *Fucus vesiculosus* and *F serratus* also of subsequent work by Lloyd Williams and by Sauvageau Overton's (1913) work on the parthenogenesis of the ova of *Fucus*, induced artificially, has been included When it was first published, the reviewer repeated it—the experiment goes beautifully Nobody appears to have used algal material for such studies since Overton published, which is strange, since sea urchin and other animal eggs have been worked at assiduously In conclusion, the Phanerogams *Zostera* and *Posidonia* are mentioned in virtue of their marine habitat, and a long list is given of the algæ of the Adriatic, North and Baltic Seas, with their vegetation periods and ease of cultivation

The whole article constitutes a very useful compendium of the present state of knowledge on this subject

Blegvad's article deals mainly with various bottom grabs, such as that of the late Director C G Joh Petersen For quantitative work, grabs are made to cover 0 1 m^2 or, for larger animals, 1 m^2 These are described and illustrated It is hard to see the value of including pictures of a dredge swung clear for use, of a boat with square net, and of partly filled sample bottles The results obtained with the bottom grabs are of great interest A figure gives the large annual variations, from 1910 until 1922, in the population density of the sea bottom at one station in *Abra alba* and in *Solen pellucidus* The bottom fauna in Timfjord is worked out in great detail in Table 1 Other tables (plates) show pictorially the distribution of animals in the various associations (*Besiedlung*, colonisation) or communities found on different types of sea bottom These are excellent, as it is very difficult to visualise the meaning of numerical fauna lists Plate XI shows the seas surrounding Denmark stippled and marked to show the areas covered by the various communities No other seas have been worked out with such detailed accuracy This article is commendably brief, and is packed with information

Our Bookshelf

Chemical Publications their Nature and Use By Prof M G Mellon (International Chemical Series) Pp viii + 253 (New York McGraw-Hill Book Co, Inc, London McGraw-Hill Publishing Co, Ltd, 1928) 12*s* 6*d* net

To the several books and various other publications that deal specifically with the topography of the literature of chemistry is now added one which, in addition to supplying the usual kind of information and advice in the manipulation of such tools as are available—extremely valuable as both are—goes a step further, and drives its lessons home by providing material for practice in the specialised technique which is described Already, of course, chemical literature has reached such vast proportions (having grown at a rate not altogether indicative of real chemical progress) that we feel a lurking sympathy for the business man who had to give up business in order to attend to his card index Moreover, the areas of intersection of chemical and other scientific spheres have tended to enlarge and become indistinctly defined

It is not surprising, therefore, that general excursions having in view an exhaustive examination, a rapid disinterment of what in the circumstances may be buried treasure, or even a hurried survey to provide a background for some commercial decision, tend more and more to be entrusted to specialists, or at any rate practicians, in the art For exactly the same reasons it is clearly desirable that students of chemistry should find time to familiarise themselves with the records of their subject The material in this book is intended to constitute the basis of an undergraduate course

There are nine chapters, in which the development of the literature, original sources (periodicals, institutional proceedings, patents, and miscellaneous contributions), and secondary sources (periodicals and serials, bibliographies, works of reference, and text books) are discussed, and the technique of the search is described The subject is placed on a class-room basis—or rather, on a library basis—by the inclusion of fourteen groups of problems (arranged in a manner somewhat reminiscent of 'prep in the lower fourth'), in which the student is required, for example, to supply full details concerning an assigned journal, to collect, complete with 'chapter and verse,'

selected physico-chemical data, or to 'look up' an organic compound Most chemists have learned the use of the literature in the school of necessity, so that although its appearance as an exercise may seem to them somewhat strange and curious, they will all the more readily perceive the advantage of early systematic direction A A E

Radiomovies, Radiovision, Television By C Francis Jenkins Pp 143 (Washington, D C Jenkins Laboratories, 1929) 2 50 dollars

C F Jenkins, the author of this work and one of the pioneers of television, took up inventing as a profession about thirty years ago He now possesses more than four hundred patents in America and other countries, and has a private laboratory in Washington for carrying out his researches He has done an immense amount of work in developing 'radiomovies,' both by using wires (television) and by transmitting them by radio waves (radio vision)

In July last, Mr Jenkins began broadcasting radiomovies at fixed times He thus gave the amateurs something for which to 'angle' A few weeks later more than a hundred amateurs had finished their receivers and could reckon with certainty on getting their regular picture stories At first only silhouettes were broadcast, as it was essential to keep the frequency band less than ten kilocycles The Radio Commission has now assigned to his company a band 100 kilocycles wide (4900 5000 kilocycles), and at the present time thousands of amateurs receive half tone 'movies' on their receiving picture sets The pictures transmitted are mainly pantomime pictures, but Mr Jenkins expects that his new machine, which is practically finished, will revolutionise the art and make it possible to transmit pictures of theatrical performances, outdoor games, inaugural ceremonies, and even grand opera with full vocal accompaniment

This book describes how to make and work a receiving set It concludes with descriptions of other of Mr Jenkins's inventions, including a landing altimeter which enables an airman to glide his machine to a landing in a fog, a novel method of predicting hurricanes by means of the snapping noises they produce in a radio receiver, and a method of guiding an aeroplane on its course in a fog He is the inventor of the motion picture projector, the principle of which is in use all over the world The Franklin Institute awarded him a gold medal for this invention in 1895

The Journal of the Institute of Metals Vol 40 Edited by G Shaw Scott Pp xii + 877 + 37 plates (London The Institute of Metals, 1928) 31*s* 6*d* net

Reports on the corrosion of condenser tubes and on the properties of alloys for die casting occupy a prominent position in the new volume The work on corrosion has had a definite result in showing that cupro-nickel and a special aluminium brass have a high resistance to attack by streams of air bubbles carried off by the water, perhaps the most frequent cause of damage. The researches of this committee have proved particularly valuable to the tube industry

Die casting has made great progress in recent years, although even now it is far less used in Great Britain than in America, and the present papers contain valuable information as to the metals best suited to this class of work W Hume Rothery describes the methods most suitable for the preparation and study of alloys containing highly reactive metals, such as sodium and calcium, and F Hargreaves continues his investigations of alloys which are softened by cold working instead of being hardened An example of the detailed study of a complex alloy system is that of the alloys of aluminium with copper, silicon, and iron by A G C Gwyer, H W L Philips, and L Mann, illustrated by very good photomicrographs and by numerous diagrams Under ordinary conditions of cooling, these alloys depart considerably from equilibrium, so that they are used in a metastable condition An unexpected result is recorded by D R Tullis, who has freed aluminium alloys from the gases causing unsoundness by passing a stream of chlorine through the molten metal, this process, unpromising at first sight, having proved to be technically successful

The volume contains many other papers and the usual abstracts

Travels and Settlements of Early Man a Study of the Origins of Human Progress By T S Foster Pp 320 (London Ernest Benn, Ltd , 1929) 21*s* net

Mr Foster has worked over the data of palæontology and prehistoric archæology in their bearing upon the distribution of man with considerable ingenuity, and still greater enthusiasm, which have involved him in frequent departures from the orthodox view He is both stimulating and provocative He is an ardent supporter of what he calls the Anatolian strain, that is, a race originating in the Anatolian plateau of what is more usually called the Armenoid type, as a factor in the development of civilisation He has allowed full play to his theory when working out racial strains in the culture of the Pacific Although it cannot be said that this is entirely assumption, the evidence is a very slender support for so elaborate a superstructure His view of the origin and growth of American culture depends upon the acceptance of the Calaveras and New Jersey skulls—which are more than doubtful—and the Central and South American early civilisations seem to be left hanging in the air

New Worlds for Old the Realm of Modern Physics By Robert G Lunnon Pp v + 106 (London Methuen and Co , Ltd , 1928) 2*s* 6*d* net

This little book is intended for those of the general public who are not acquainted with the modern developments of physics It is a perfectly accurate, though necessarily incomplete, account of the discoveries of the last twenty five years The writing is most suitable for a book of its kind, and the average reader is not likely to arrive at false conclusions, as is so often the case, through the fact that the terminology is beyond him

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return nor to correspond with the writers of rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications*]

The Nature of the Penetrating Radiation

UP to the present time the view that the penetrating radiation consists of short gamma rays has been prevalent chiefly because the large penetrating power which these rays possess is associated with radiation of gamma ray type Our recent experiments however indicate that this radiation is of corpuscular nature

The experimental arrangement consisted simply of two tube counters of the type recently developed by Geiger and Muller (*Die Naturwiss* **16**, 617 1928) which were placed above one another at some distance apart in a space screened by 6 cm of lead and 5 cm of iron Each of the counters was connected to an electrometer and the deflections of the two electrometers which were due chiefly to the penetrating radiation (Geiger *Phys Zeitschr* **29** 839 1928) were registered side by side on a moving film With this arrangement a considerable number of simultaneous deflections of both instruments was recorded For small distances between the counters up to about 20 per cent of the total number of deflections of one counter were coincident pairs This percentage is so great that it must be explained on the basis that coincidences occur if the same corpuscular ray enters both counters

Two hypotheses may be made concerning the origin of this corpuscular radiation One is that the primary radiation may be of the gamma type and the coincidences the result of secondary electrons In this case one would expect the corpuscular rays to be more easily absorbed than the penetrating radiation that caused them The alternative is that the penetrating radiation is really of corpuscular nature in which case agreement should exist between the absorption coefficient of the rays causing the coincident deflections and that directly measured for the penetrating radiation itself

In order to distinguish between these alternatives a block of gold 4 1 cm thick was placed between the counters the diminution in the number of coincidences thereby giving a measure of the absorption of the corpuscular rays The first attempts were made in a laboratory of the Reichsanstalt where the thick floors and ceilings of the rooms above us greatly hardened the radiation There was no definite diminution in the number of coincident pairs under these conditions We then repeated the experiment on the roof of the building with the lid of the screen removed Under these conditions the unfiltered radiation from above acted directly on the counters and a definite diminution in the number of coincidences was observed on introducing the gold block The observed difference gives (μ/ρ) Au $= (3\ 6 \pm 0\ 5) \times 10^{-3}$ for the mass absorption coefficient This value agrees well with that measured directly for the unfiltered cosmic rays We conclude from these data that the penetrating radiation is not of gamma but of corpuscular type

The complete description and discussion of these experiments will appear in the *Zeitschrift fur Physik*

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Temperature Conditions in the Suez Canal, July December 1928

THE study of the temperatures met with in the Suez Canal is invested with more than ordinary interest in view of the linkage affected between two different sea areas and the possibilities of an exchange of faunas

The Cambridge expedition to the Suez Canal (*Transactions of the Zoological Society* 1927) has shown that more marine animals have moved from the Red Sea to the Mediterranean than from the Mediterranean to the Red Sea The expedition also published valuable evidence to show that for most of the year the canal water was under the influence of a slow residual drift from the Red Sea This however was reversed during the months of the Nile flood

In studying the question of the migration of young or drifting organisms through the canal temperature has very rightly been considered as of first importance as a possible limiting factor

The only series of data concerning the temperatures of the canal that offer anything like a contemporaneous series are those taken by the *Pola* expedition in October 1895 and May 1896

The present observations were all made within two days on each occasion and so were very nearly simultaneous

The following list shows the positions at which they were made

Suez Canal Station 1 Opposite entrance buoy to Suez Canal Port Said
2 Opposite Canal Company s signal station at Ballah
3 1 kilometre S E of the Canal Company s landing stage at Ismailia
4 Opposite the Northern Light Buoy of the Great Bitter Lakes
5 Kilometre 130 of the Canal
6 Opposite the last buoy but one of the Suez Canal at Suez

It is the intention of the directorate of Fisheries Research Coastguards and Fisheries Service to take routine temperature and salinity observations from these positions over a run of years

The surface observations for July 1928 and February March 1929 are shown here

Station		S C 1	2	3	4	5	6
Date		19 7 28	19 7 28	19 7 28	20 7 28	20 7 28	20 7 28
Time		1043	1450	1637	1228	1628	1855
Temperature	C	28 92	29 28	29 60	29 18	28 85	26 55
Date		28 2 29	28 2 29	28 2 29	1 3 29	1 3 29	1 3 29
Time		1034	1505	1705	1139	1843	1753
Temperature	C	14 32	14 70	14 96	15 25	17 85	17 53

A Nansen Petersen insulated closing bottle was used with a Schmidt thermometer

Examining the Cambridge and *Pola* expedition temperatures one is struck by the anomaly of higher figures for Port Said than for Suez This same condition is shown in my figures for July In February–March however, there is a higher temperature at Suez than at Port Said and from Station S C 2 to Suez there is a steady rise along the whole length of the canal

There seems to be then a higher temperature at the northern end of the canal than the southern in summer, and a higher temperature at the southern than the northern end in winter This relatively higher summer temperature of the water at Port Said is quite inexplicable on ordinary considerations of position and I am led to suggest the following explanation

The sea in the neighbourhood of Port Said is constantly receiving Nile water This comes out through a large shallow lake—Lake Menzaleh—and in the summer and autumn through the Damietta mouth of the Nile Travelling through a thousand miles of heated desert—partly discharging through a shallow lake which is rapidly heated by the sun—the effluent water of the Egyptian Nile is much hotter than that of the Mediterranean Sea in the summer

The order of the temperatures in these delta lakes is well shown by Paget (Fisheries Report of Egypt, 1921) It will be seen that the average monthly temperature in August and July is 30° C

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Mar 26

Anti-Knock Ratings of Pure Hydrocarbons

PROF NASH and Mr Howes emphasise the fact that whereas their figures for trimethylethylene and diamylene were quoted for twenty per cent volume concentration, our own were for twenty per cent weight concentration From curves obtained for these hydrocarbons reproduced in Fig 1, it is clear

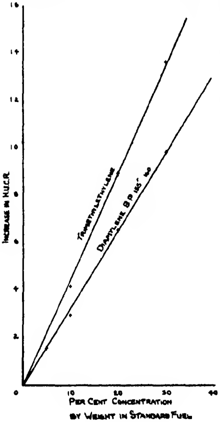

FIG 1

that over the range examined the relationship between weight-concentration and increase in H U C R is linear Knowing the specific gravities, it is a matter of simple calculation to show that the discrepancy cannot be due to our use of what we regard as the only rational procedure The specific gravity of the standard fuel was 0·725 at 60° F

So far as the possible effects of volatility are concerned, all tests at these laboratories are carried out with sufficient intake air, heating, and jacket and head temperature to ensure that no appreciable difference in anti knock rating is found with any further heating whether low boiling gasolines or heavy kerosines are being tested

The recent recommendations made by Campbell Lovell, and Boyd regarding the importance of making all comparisons at the mixture strength which gives maximum pinking have been in use here for upwards of two years The Armstrong engine developed independently in these laboratories while their work was in progress includes both variable compression head and bouncing pin

In order to find definitely whether differences in volatility are the cause of discrepancies between one fuel and another, experiments have been carried out with

1 Standard heating conditions and compression adjusted to suit the sample

2 Evaporative cooling, high compression and throttling to control the pinking as is the practice when using the Delco engine

The mean results were identical, although the values of single readings using the second set of conditions were more erratic owing probably to the method of cooling which tends to induce stray hot spots

We feel that possibly complete agreement might be reached on those points still in doubt if tests were carried out using a common supply of trimethylethylene and diamylene in both engines, employing a range of air fuel ratios

In the case of the Ricardo E 5 engine and the Armstrong engine used in this laboratory, the effect of air fuel ratio has already been thoroughly studied Similar experiments could be made without alteration to apparatus on the Delco plant, and we have no doubt concerning the ultimate results

Confirmation of the accuracy of our figures is afforded by the fact that substantially identical values are obtained using such a wide range of research engines as

(a) The Thornycroft overhead valve engine of 1025 c c capacity (b) The Ricardo sleeve valve engine of 350 c c capacity (c) The Armstrong engine with a fixed ratio head (d) The Armstrong engine with a variable compression head

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WE would thank the Editor of NATURE for kindly allowing us to reply to the above letter of Messrs Birch and Stansfield, but feel that we must not trespass on the space of this journal any further in that all contribution to our knowledge of the subject under discussion ceased with our letter which appeared in the issue of April 6

In our previous communication no suggestion was made that the difference in the results obtained for diamylene and trimethylethylene was due entirely to the fact that Messrs Birch and Stansfield employed concentrations by weight, whereas we used concentrations by volume Nevertheless, the fact must necessarily contribute to the discrepancy

It is also not impossible that the samples of diamylene as used by Messrs Birch and Stansfield and ourselves were not chemically identical The boiling ranges were not the same, and seeing that the diamylene as made from trimethylethylene is

probably not a single chemical entity but a mixture of isomers, the composition of the diamylene produced may vary with the method and condition of the particular polymerising reaction used Diamylene, prepared in this way, cannot be chemically described with the same certainty that would be associated with trimethylethylene

With regard to the other point raised, it is well known that differences in results obtained by different workers with different engines may be due to technique and design, and it is well realised that concordant results will never be obtained until a standard method of test is employed by all laboratories

We welcome Messrs Birch and Stansfield's suggestion of carrying out tests using a common supply of trimethylethylene and diamylene in both types of engine, as we feel that such collaboration would result in a much greater advance than further correspondence at this stage of our knowledge

In the meantime, it is known to us that research workers in the United States have been carrying out similar investigations for some years, and now that the results of our work have been disclosed, it would add materially to our knowledge of the subject if they would publish their conclusions

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Rise and Fall of the Tides

From information published by the Hydrographic Department of the Admiralty it is possible to find the rise and fall of the tides and the times of high and low water on almost all the coasts of the world except in the extreme north and south latitudes

The periods of the tides depend on astronomical conditions, and the many terms which are involved have been investigated The periods, however, furnish no information as to the tidal range, that is, the difference in elevation between high and low water

A very simple calculation, however, depending merely on the masses and distances of the tide producing bodies, suffices to show that were the earth fluid and devoid of rigidity, then the difference between the semi axes of the tidal spheroid would be of the order of one in twenty million, or about a foot at the earth's surface

From the Admiralty Tables it will be seen that on coasts facing the open ocean the observed rise and fall in relation to the land lies somewhere between 5 and 10 feet on the average, but that where the coast line is complicated and the water shoals gradually, far greater variations appear, which may range from 0 to 50 feet

It is not necessary to go outside the English and neighbouring coasts to find examples of such differences For example, near the mouth of the English Channel the rise and fall is about 20 ft , in the Bristol Channel, nearly 50 ft , at Portland, about 5 ft , and in the neighbourhood of Mt St Michel, 50 ft These large differences may be accounted for in part by interference, that is, by the tide reaching the position of observation by different routes of unequal effective lengths, or again, resonance may be involved, as is apparently the case in the English Channel, where high and low water at the opposite ends occur at the same time

The most general cause, however, which operates to make the coastal rise and fall so much larger than the equilibrium tide in the open ocean, is the gradual concentration of energy which occurs when a wave of small amplitude but large mass travels from deep to shallow water

Among many familiar examples which depend on the same sort of concentration of a constant amount of energy in a gradually diminishing mass, may be mentioned the cracking of whips, flapping of flags and sails, throwing a rope, and throwing a fly, and I will add three more where the results can be readily calculated

(1) A heavy flexible cord passes through a hole in a fixed horizontal plate That part of the cord which hangs free below the plate is given a small horizontal velocity and swings as a pendulum The cord is then drawn upwards through the plate Above the plate the cord is stationary, and the energy it contained is transferred to the part still hanging free, the mass of which continually decreases with the length of the free part Hence the horizontal velocity of that part tends to become infinite when the length vanishes

(2) A light reel is wound with a few turns of massive but flexible cord and placed on a horizontal table to which one end of the cord is attached Two forces act on the reel, both tending to make it roll away from the point of attachment of the cord to the table, namely (*a*) the weight of one half turn of the cord acting at half the radius of the reel, and (*b*) the horizontal component due to the centrifugal force of the mass of half a turn of the cord at the velocity of the rotation of the reel As the rolling proceeds the cord is left at rest on the table, and the energy is gradually concentrated in the remaining turns Hence the angular velocity tends to become infinite as the last part of the cord leaves the reel

(3) An endless massive but flexible belt connects two wheels lying in the same plane The wheels are given a certain spin, and both parts of the belt are then cut at the same instant half way between the wheels What is the subsequent motion of the two parts of the belt ? Before cutting, the total momentum is zero If the line joining the centres of the wheels is taken as the axis of X, the momentum parallel to X remains zero for both parts, but after the cut is made is equal and opposite in direction for the two parts its amount being the component parallel to Y of those parts of the belt which are in contact with the circumference of the wheels The centres of inertia of each part remain at a constant distance from Y, but move at a constant speed parallel to Y, one to the right and the other to the left of X according to the direction of the spin It will be found that the cut parts of the belt assume in succession the shape of alternate right handed and left handed pot hooks, becoming straight lines for a single instant with an infinite terminal velocity parallel to Y

How very large the velocities attained by the concentration of energy may become in real cases is shown by the crack of a whip, where the few feet per second originally given to the lash rises to explosive velocity at the last instant

The gradual increase in the height of gentle waves as they approach a shelving beach is familiar to most people, and the same sort of action must accompany the small disturbance which constitutes the tidal wave in deep water as the latter shoals

What the equilibrium rise and fall relative to the floor of the deep sea really is, is quite unknown either by observation or by theory

In the *Phil Mag* (vol 50, pp 228, 278) there are papers by Sir G B Airy and Sir William Thomson which touch on this subject and on Laplace's theory of the tides Airy objects to some of Laplace's work which is upheld by Sir William Thomson

Laplace's spherical harmonics are so general as (if the restriction is not specially introduced) to cover the introduction or withdrawal of fluid at the poles —the condition of constancy of fluid volume was in

effect introduced by Laplace, and this Airy calls a "singular and unwarranted principle" Sir William Thomson says this unwarranted principle is in fact an "exquisitely subtle" method by which Laplace determined a certain constant, and Airy rejoins, "I look on Laplace's process as a mere sport with symbols and on Laplace's conclusion as a grievous error" Whether, however, Laplace is right or wrong, his conclusion applies to an ocean covering the whole surface of the earth, and would not help to determine the motion of the fluid as actually distributed in the existing seas

The question of the earth's rigidity also would have to be settled before any theory could give a quantitative estimate of the true amplitude of the equilibrium tide

Sir William Thomson (Thomson and Tait's "Natural Philosophy") states that unless the rigidity of the earth was at least as great as that of iron or glass, the tidal rise and fall would not be so great as it actually is In view, however, of the want of deep sea observations and of the amplification which occurs near a coast line, the necessity for such rigidity does not seem to be proved

I think the only satisfactory way to ascertain the amplitude of the tides in the deep ocean is by direct measurement, and though this presents some practical difficulties, it ought not to be impossible

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Evolution through Adaptation

DR BATHER'S lecture on "Evolution through Adaptation," printed in NATURE of Mar 30, bristles with debateable points, but I will select a cardinal one which appears to present a fundamental difficulty in his theory He speaks of the changes of depth and salinity in the waters which have taken place in geological time and draws the conclusion "that the surroundings of a race are continuously altering, the race has perpetually to catch up with the change" But even if the small changes that have taken place in the oceanic environment could account for the trend of evolution, for example, from an Asteroid to an Echinoid form in the Echinodermata, how could be explained the persistence of the original Asteroid type practically unchanged? The race has not changed, if certain members or groups of it have

Dr Bather points out that "there is some tendency for change of form and structure to proceed in a definite direction," but he goes much further in stating that "the direction will accord with the environment" Apart from lethal factors in inheritance and non viable monsters, what evidence is there that new forms in animal evolution are necessarily more in harmony with their environment than were and are the forms from which they arose? For example, many Echinoid and Asteroid forms share the same environment in the sea, but the Echinoid type is believed to have evolved from primitive Asteroidea How does the Echinoid trend of evolution accord better than does the Asteroid with the environment which they both share? Migration as a factor in isolation of species can be ruled out, of course, if the original and the 'evolving' line have always shared the same environment

The mutations required by Dr Bather's theories can of course be admitted, as they can be seen and investigated, but they only "provide that fundamental premise from which, *in combination with a varying environment* [italics mine], one can deduce irreversibility of evolution and orthogenetic trends" This would be true only if it could be shown that the varying environment favoured the new forms at the expense of the old, but actually the older forms are often as well adapted to the varying environment as are the new ones Another objection is that, while the slight changes that have taken place in the physical and chemical constitution of the ocean would affect such processes as fertilisation and early development in various ways, it is difficult to imagine how such changes can have directed the general "orthogenetic trends" in adult oceanic forms Furthermore, the persistence of primitive or early forms in the same environment is evidence against such a view

J S DUNKERLY

IN speaking of "Dr Bather's" theory and theories, Prof Dunkerly pays me too much honour That portion of my discourse which appeared in NATURE attempted a critical inquiry into other people's theories and a possible explanation of certain difficulties that they presented to my mind To Prof Dunkerly's mind the main theory presents yet another difficulty He admits, apparently, the fact of evolution, and he admits some change of environment, but he urges (I understand), first, that the changes of environment are too slight to produce the great evolutionary changes seen along certain lines, secondly, that if they were a *vera causa* they would have affected all lines of descent in a more equal degree

It is rather late in the day to be answering arguments of this kind, and space could not be afforded in NATURE for their adequate discussion May I suggest, first, that Prof Dunkerly underestimates the differences and the changes in the environment of sea animals? If he derives his conception from a single summarising sentence in my discourse, I would remind him that two thirds of that discourse (not reported in NATURE) was devoted to an illustrated account of some among the numerous and varied habitats, conditions, and modes of life that a single class of marine invertebrates (and a statozoic class at that) has come to fill during its long history It was emphasised that a single small patch of sea floor, which we speak of roughly as sand or sea weed or reef and so forth, really comprises many habitats On the other hand, it was urged that, just as one cannot envisage a living creature apart from its environment, so one should not conceive of the environment without the reaction of the creature, further, that the whole creature constitutes the environment of any one of its parts

Consider 'migrations,' on which Prof Dunkerly seems to misapprehend me Surveys of the sea floor, notably by the Danes, have shown that the immigration or emigration of a single species from or to a faunal assemblage on a small patch must, and does, affect the life of all the other species, although purely physical conditions are unaltered Or take mutation (which Prof Dunkerly admits) and consider the Cladocera mutant found by Banta and Wood (see NATURE, Oct 29, 1927, p 632), here is a form that can live only at a temperature higher than the normal, and if it does find a warmer pool it will be preserved as a race adapted to a new environment This does not mean that the original race will perish Why starfishes should disappear because sea urchins have (according to Prof Dunkerly) been evolved from them, I quite fail to understand They fill different places in the economy of Nature, and to say that any of them "share the same environment" is scarcely so true as would be a like statement about a groom and his horse I wonder what my friend Dr W K,

Spencer will say to the assertion that the original Asteroid type has persisted unchanged

Prof Dunkerly tells us that changes in the ocean water would affect fertilisation and early development I said nothing about this, but what difficulty is there in supposing that embryonic change affects the adult history? We all know that it does, and the results might manifest just as much regular seriation as appears in any alleged orthogenetic trend However, I do not remember touching on this in that part of the discourse which Prof Dunkerly has been so good as to discuss

F A BATHER

The Fine Structure of the Normal Scattered Molybdenum $K\alpha$-Radiation from Graphite

IN the September issue, 1928, of the *Physical Review*, B Davis and D P Mitchell reported an experimental investigation of the molybdenum $K\alpha$ radiation scattered by graphite with the aid of an ionisation spectrometer In their work it is stated that the normal scattered radiation should have a much more

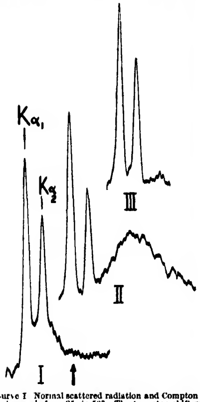

FIG 1—Curve I Normal scattered radiation and Compton scattering Scattering angle from 25 to 50° The Compton shift ranges from about 2 to 9 X units
Curve II Normal scattered radiation and Compton scattering Scattering angle from 45 to 130 The Compton shift ranges from about 7 to 40 X units
Curve III Direct radiation from molybdenum anticathode

complicated structure than the primary radiation Instead of the one $K\alpha_1$ line they find four lines one in the same position as the $K\alpha_1$ line and three lines shifted to the long wave length side by 1 2, 2, 11 3 X units respectively, the distance between the $K\alpha_1$ and $K\alpha_2$ being 4 28 X units As these shifts correspond more or less accurately to the L_{III}, L_I, and K level of the carbon atom, the effect reminds one of the well known Raman effect in the optical region

Because of the high theoretical importance of these experiments, we have tried to repeat them, using the photographic method, but we failed to detect any difference at all between the structure of the primary radiation and that of the 'undisplaced' scattered line In the meantime, Ehrenberg (*Zs f Phys*, **53**, 234, 1929) published an analogous negative result Still, we think it worth while to give a short discussion of our work in view of the importance of the problem in question

The spectrograph used was of the Siegbahn type, calcite was used as analysing crystal, the dispersion was such that the distance between the $K\alpha$ lines was 0 19 mm on the photographic plate The scattering graphite was put on the cathode inside the X ray tube, the alternating tension was 35 kv eff, the current 25 ma By taking control photographs it was ascertained that only the radiation scattered by the graphite could reach the photographic plate All the photographs taken were registered with a photometer of the Moll type (see Fig 1) Plate I was taken with the graphite at a distance from 5 to 15 mm from the anticathode focus The time of exposure was 35 hours At the small scattering angles from 25° to 50°, the Compton scattering is confused with the normal scattered lines At a distance, however, of 11 3 X units from the normal $K\alpha_1$ line where Davis and Mitchell found their weakest component of the scattered complex line (see arrow to curve I), we see that there cannot be any line with an intensity of more than 2 per cent of that of the scattered $K\alpha_1$ line Plate II was taken with the graphite at a distance from 15 to 20 mm from the focus The time of exposure was 75 hours On this plate the region between the $K\alpha_1$ and $K\alpha_2$ is wholly free from Compton radiation In this region Davis and Mitchell found two other components of the complex line From a comparison, however, of curve II with curve III, which relates to the spectrum of the direct radiation, we conclude that there seems to be no essential difference at all between the normal scattered $K\alpha$ doublet and the direct radiation

It might be remembered that if there should exist in the X ray spectrum something analogous to the Raman effect in the optical region, we should expect this to give rise not to lines but to a *continuous* spectrum, which we should not be able to detect with the means used in our experiments

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Variation of Conductivity of the Upper Atmosphere

MEASUREMENTS of the height of the base of the aurora in northern Norway by C Störmer (*Geofys Publ*, I, No 5) and by L Vegard and O Krogness (*Geofys Publ*, I, No 1) show that a considerable number of the bases are situated at heights of about 100 km and about 106 km (compare the frequency curve, Fig 18, *Geofys Publ*, I, No 1, p 101) In treating 1737 base heights between 90 and 120 km it was found from the frequency curve that during ebb tide in the atmosphere the maximum at 100 km was predominant, while during flood tide the maximum at 106 km was predominant Further investigations have shown that the maxima of the frequency curve are to be considered as displacements of one and the same maximum. From this we conclude that, as regards the locality considered, the mass of air situated above 100 km at ebb tide is the same

as the mass of air situated above 106 km at flood tide

When adopting all the assumptions and results given in "The Propagation of Radio Waves" by P O Pedersen (Copenhagen, 1927), it is possible to show how the conductivity of the upper atmosphere (130 160 km) is influenced by the different states during ebb tide and flood tide Let us assume that the mass of air above a certain height varies with height in accordance with an exponential function, and let us consider, within the conducting layer, a thin layer under normal conditions and with a certain conductivity Then the problem consists in finding the variation of the conductivity caused by the atmospheric tide On account of the slower decrease in the vertical direction of the mass of air above a certain height, a thin layer with the same electric properties as the above mentioned thin layer will grow thicker at flood tide, while at ebb tide a corresponding thin layer will grow thinner The total conductivity will therefore vary according to the atmospheric tide For the place of observation (70° northern latitude), the total conductivity is found to be 4 3 per cent greater at flood tide than at ebb tide

Considering the lunar diurnal magnetic variation as a variation caused in the solar diurnal variation by tidal forces, and supposing proportionality between the conductivity in the upper atmosphere and the magnitude of magnetic variations (S Chapman), it is found from the variations of the magnetic declination that near the equator (Batavia) the conductivity at flood tide is 21 per cent higher than at ebb tide For latitude 70° an increase of 2 5 per cent in the conductivity from ebb tide to flood tide is to be expected The discrepancy with the above result is removed when, instead of a supposed temperature of the stratosphere of −54° C, a temperature of −78° C is used, after Dobson (*Proc Roy Soc*, A, vol 103, pp 339 342) such a temperature of the stratosphere may be possible during the nights in which the measurements of the base heights of the aurora have taken place A consequence of the above is that the height of the conducting layer will vary during the lunar day In latitude 45° a variation of 25 per cent from the mean height may be expected, a point on which the investigation by radio waves may be able to throw some light

Summarising, it may be said that the heights of the base of the aurora are able to give information on the tide of the upper atmosphere and thereby on the variation of the electric conductivity in the regions considered, further, that certain observed magnetic variations seem to confirm the result found The existence of a resulting enormous variation of the height of the conducting layer may be tested by means of radio waves

J EGEDAL

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Mar 25

A Violation of the Selection Principle for the Principal Quantum Number

ONE of the selection principles, for the case of X ray spectra, states that the principal quantum number must change in any electron transition A thorough investigation was carried out by Coster (*Phil Mag*, **43**, p 1070, 1922) to determine if lines could be found corresponding to electron transitions between L levels, but no such lines were observed No violations of the principal quantum number selection rule have yet been found By using the grating method, Thibaud and Soltan (*Journal de Physique*, **8**, p 485, 1927 *Phys Zeit*, **29**, p 241, 1928) found two new lines for the elements tantalum (73), tungsten (74), platinum (78), and gold (79), and they also found that the values of ν/R for these lines corresponded approximately to those given by Bohr

LINE WITH SHORTER WAVE LENGTH

Element	λ(A)	$\frac{\nu}{R}$ (Obs)	$\frac{\nu}{R}$ (Cal)					
	Thibaud and Soltan	Thibaud and Soltan	$N_{IV}\ N_{VI}$	$N_{IV}\ N_{VI\ VII}$	$N_{IV}\ O_{II\ III}$		$N_{IV}\ O_{I}$	
			Idei	Bohr and Coster	Idei	Bohr and Coster	Idei	Bohr and Coster
Ta (73)	58 3	15 6	15 9	15 5	15 0	15 4	12 6	12 7
W (74)	56 0	16 3	16 4	16 2	16 0	15 8	13 3	13 5
Pt (78)	48 0	18 9	18 8	19 3	20 2	15 9	16 8	17 4
Au (79)	46 8	19 5	19 6	20 0	21 7	18 1	18 2	18 6

LINE WITH LONGER WAVE LENGTH

Element	λ(A)	$\frac{\nu}{R}$ (Obs)	$\frac{\nu}{R}$ (Cal)					
	Thibaud and Soltan	Thibaud and Soltan	$N_{V}\ N_{VI\ VII}$		$N_{V}\ O_{II\ III}$		$N_{V}\ O_{I}$	
			Idei	Bohr and Coster	Idei	Bohr and Coster	Idei	Bohr and Coster
Ta (73)	61 4	14 8	15 0	14 7	14 0	14 6	11 7	11 9
W (74)	59 1	15 4	15 4	15 3	14 9	14 9	12 2	12 6
Pt (78)	51 0	17 8	17 8	18 0	19 0	14 6	15 6	16 1
Au (79)	49 4	18 4	18 4	18 6	20 4	16 7	16 8	17 2

and Coster for $N_{IV}\ N_{VI,\ VII}$ and $N_{V}\ N_{VI\ VII}$ respectively, but, due to the inaccuracy of the values for the energy levels, especially for the O_{I} and $O_{II\ III}$ levels, they were not able to reach any definite conclusions In a later paper, however, Thibaud (*J O S A and R S I*, **17**, p 145, 1928) ascribes the origin of the two new lines to transitions between the O (probably $O_{II,\ III}$) level and the N_{IV} and N_{V} levels

I have recently made some careful measurements in the L series, the results of which make possible a more accurate determination of the values of ν/R for the levels in question These values, as well as those of Bohr and Coster, are given in the table above with the values of ν/R for the two newly discovered lines Judged from these new values, it would seem just as likely that the doublets found by Thibaud and Soltan are due to the transitions $N_{IV}\ N_{VI}$ and $N_{V}\ N_{VI\ VII}$ This would then be the first experimental evidence of X ray transitions within levels of the same principal quantum number

SAKAE IDEI

Physical Laboratory, Upsala,
Mar 7

Combustion of Rigidly Dried Carbonic Oxide-Oxygen Mixtures

THE paragraph in NATURE of April 13, p 584, referring to my paper on 'The Combustion of Well dried Carbon Monoxide and Oxygen Mixtures" in last month's *Proceedings of the Royal Society*, contains a statement which, if allowed to pass uncorrected, might convey a wrong impression

It is scarcely true to say that our previous experiments on the combustion of six months phosphoric anhydride dried mixtures of carbonic oxide and oxygen had been criticised ' on the grounds that inadequate precautions had been taken to remove occluded hydrogen from the platinum electrodes between which the igniting spark was passed,' although it may be that in NATURE of Sept 24, 1927, Prof H E Armstrong had queried whether possibly "hydrogen, imprisoned in the platinum electrodes" had been "extruded into the gas '

In describing, in my recent paper, our further experiments—the object of which was to test whether a prolongation of the phosphoric anhydride drying up to 550, 750, or even 1000 days (instead of the former 170 220 days) would make any difference to the results—I was careful to explain (1) that, in all the previous experiments, the electrodes had been 'glowed out' repeatedly in a high vacuum for many hours (at least 20 in all), so as to remove occluded hydrogen from them, and (2) that, in the further ones, the additional precaution had been taken of electrically 'glowing out' the electrodes in oxygen at low pressure, as well as in a high vacuum, both of which operations were continued many hours

I do not think there can be any reasonable doubt of the adequacy of the measures taken in the previous experiments to remove occluded hydrogen from the platinum electrodes, in the later ones, the further precaution referred to was taken merely to make assurance doubly sure', and, seeing that the results of the two series did not differ in any material respect, the adequacy of all precautions in both is assured Indeed, the fact that in both series condenser discharge sparks of anything up to 0 5 micro farad at 1000 volts were repeatedly passed (between platinum balled electrodes) through the phosphoric anhydride dried medium, without even the faintest sign of ignition being discernible photographically, may be regarded as a conclusive test, not only of its extreme dryness, but also of the total exclusion of hydrogen from it

The experimental results now enable us to say quite definitely (1) that a highly purified $2CO + O_2$ mixture which, under all necessary precautions, has been rigidly dried to the utmost limit possible with re distilled and highly purified phosphoric anhydride, will still explode and propagate flame provided that a sufficiently powerful igniting spark is used, and (2) that with platinum balled electrodes the minimum condenser discharge spark required is about 0 75 microfarad at 1000 volts (energy = about 0 75 Joule)

WILLIAM A BONE

Imperial College of Science and Technology,
London, April 16

Titanium Oxide Bands in the Orange, Red, and Infra-Red Region

BANDS in the region of λ5600 to λ8000 have been analysed into at least two systems, distinct from that of the blue green region, previously analysed by Birge and Christy (*Phys Rev*, vol 29, p 212, 1927 Abstract NATURE, vol 122, p 205, 1928) One of these in the orange is a singlet system due to the electronic transition ${}^1P - {}^1S$, the other a triplet system in the red and infra red due to the transition ${}^3S - {}^3P$ Of the former only one sequence has yet been found, of the latter, four have been determined, namely, the (0, 1), (0, 0), (1, 0) and (2, 0), the $\Delta\nu$ separations of the triplet heads of the (0, 0) sequence being 66 7 and 74 6 cm $^{-1}$ respectively

The molecular constants, determined from the vibrational analysis of the triplet system, show that in the final state the vibrational frequency of the rotationless molecule with infinitesimal amplitude of vibration is the same as in the blue green system, and that thus their final energy level, ${}^3P$, is the same Further, since the separation of the triplets of red infra red system pertains to this final level, it pertains also to the final level of the blue green system

Analysis of the other bands found in the red is in progress

F LOWATER

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Mar 28

Ozone Absorption during Long Arctic Night

I HAVE been trying for the past ten years to interest the astronomers in having photographs of stellar spectra made during the long arctic or antarctic night, on the chance that the ultra violet cut off due to ozone may be less powerful, and I mentioned it to Prof Russell last spring I have always emphasised the importance of choosing a station so situated that there will be a minimum chance that ozone formed in the illuminated regions will be carried over into the dark region by atmospheric circulation Information regarding the direction and velocity of the upper atmospheric current will be necessary in choosing the site It should certainly be nearer the pole than the station occupied by Prof Rosseland (NATURE, Feb 9, p 207), for the sun at noon was only three or four degrees below the horizon, and the air five miles above the surface was in full sunlight, as Prof Russell pointed out to me His negative result I do not regard as decisive, though I am not very hopeful that much or any extension of the spectrum will be found, as ozone is fairly stable An objective prism pointed at the pole star seems the simplest device

R W WOOD

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Lengthened Chain Compounds of Sulphur with Platinum

IN NATURE (Jan 22, 1927, p 124) a lengthened chain compound of sulphur of the formula $BrC_2H_4(SC_2H_4)_{48}Br$, as also another of sulphonium sulphur having so high a molecular weight as 3472, have been described

Recently, in collaboration with K C Bose Rây, I have prepared another series of complex sulphur platinum chain compounds (*Zeit anorg Chem*, Bd 178, p 329, 1929) the first member of which has the formula Pt_2Cl, $2(C_2H_5)_2S_2$, $2NH_3$, $6H_2O$, and the last $Pt_{13}Cl$, $10(C_2H_5)_2S_2$, $2C_2H_5NH_2$, $8H_2O$, with a molecular weight as high as 4050 5 This is perhaps the only example as yet known of a metallic compound synthesised in the laboratory and possessing such a high molecular weight

P C RÂY

University College of Science and Technology,
Calcutta, Mar 13

Science and Hypothesis

By Sir OLIVER LODGE, F R S

RECENT speculations in mathematical physics, and acquiescence in treatment in terms of unimaginable abstractions, have raised a general question about the use of hypothesis as a means of co-ordinating observations, stimulating experiment, and paving the way for a theory It is possible to experiment not only in the laboratory with matter, but in the study also, with symbols and a great deal of modern mathematics is of an experimental character A hypothesis is boldly made, some indication of its plausibility having been detected by a flash of genius, it is then developed and its consequences worked out If the consequences are evidently leading astray, it is abandoned but if like Planck's, like de Broglie's, and like Bohr's—to go no further—they lead in a helpful direction, yielding results that can be compared with metrical determinations, then the hypothetical formula attracts attention and begins to be accepted as the basis of a partial theory, even though its full significance is not understood, the reasons for it only dimly apprehended, and though the agencies with their mode of working are in the main unknown

Experience has shown that a working hypothesis may be a true guide so far as it goes, even though it has in the end to be so extensively supplemented as to be revolutionised The precision attainable varies in different branches of knowledge only in a few subjects can the results be expressed and checked with numerical accuracy In physics and astronomy we have grown accustomed to these precise modes of verification, though even here the verification may not substantiate every detail of the original hypothesis or prevent its complete recasting in the light of further knowledge The quantum was appealed to as somehow securing the stability of Bohr's electronic orbits, but further treatment by Schrodinger put a different complexion on the electron and the final word has not yet been said Still, the quantitative results attained by Bohr's theory, spectroscopically verified to many places of decimals, were amply sufficient to justify us in enthusiastically welcoming the partial clue provided

Not often is such numerical precision attainable, sometimes only the order of magnitude can be checked, and sometimes the agreement with fact is not quantitative at all Even in chemistry the constitution of certain molecular compounds was arrived at by a special instinct, and was accepted long before physicists began to scrutinise the molecules and ascertain that their constitution was more or less in accord with the intuitions of genius In biology such direct verification is still far off, and seldom can any theories be brought to the test of quantitative determination In anthropology and sociology, in addition to all the other difficulties, an element of caprice enters in Humanity is not so amenable to law and order as molecules are, and individual behaviour can scarcely be predicted or specified with anything approaching completeness A statistical result may be arrived at, and the average behaviour of a large group can be stated with approximate correctness, subject to disturbing causes Even in molecular physics the laws of probability tend to supersede the accurate dynamics of individual occurrences, and we have to be satisfied with a sort of average uniformity variegated and enlivened by individual eccentricities

Psychologists and psychiatrists seek to penetrate the meaning of perverse peculiarities and to ascertain the laws of individual behaviour so far as they can The introduction of what we call chance and caprice makes a scientific treatment more difficult, undoubtedly, but it does not prevent the subject from being pursued in a scientific spirit Methods and results must vary according to subject matter and what would be vague in physics and chemistry may be unusually definite in subjects like biology and psychology Even in physics an element of indeterminism has recently been suspected certainly the molecules of a gas are behaving in an apparently lawless manner, while yet their average or aggregate behaviour on a large scale is satisfactorily uniform

As to the illegitimacy of hypothesis in science, that is absurd Every theory began as a hypothesis It is to test a hypothesis that every elaborately planned experiment is made As a digression it may be worth insisting that Newton himself constantly made hypotheses,—his queries at the end of 'Optics' are a collection of them,—and gravitational astronomy itself must have begun as a hypothesis When engaged in deductively working out results of theory on a mathematical scheme, he did indeed, and very properly, say, "I am not making hypotheses," using the present tense in a perfectly grammatical and intelligible manner though the sentence is often mistranslated or misinterpreted in a form covering both past and future, as if he had said, I do not make, or I never make, hypotheses Which would have been merely false

The ether of space is a hypothesis, rendered necessary by the complex behaviour and properties which have to be attributed to what we call empty space, that is, space empty of matter Regarded philosophically it seems impossible to imagine the space between atoms and worlds as really empty, it is only empty of everything that appeals to our senses and is amenable to direct experiment The nature of space is inferred, and has to be inferred, from its effects on matter but the inference that there must be something literally 'sub-stantial' in space, which is really responsible for cohesion, elasticity, and all the other manifestations, is inevitable, though in expressing such behaviour (electrical, optical, gravitational) it is the results and not the mechanism that we formulate, for the mechanism seems to be unlike any mechanism with which we are acquainted, and is still essentially unknown

Objections to the ether are really objections to the nineteenth century conception of an ether expressed

in terms of mechanical models No such ether exists the real ether is too fundamental an entity to be expressed in terms of the sensory perceptions of material behaviour, which is what we usually mean by explanation In so far as it is unexplained and not amenable to experiment—so long as it is a sort of hypothesis *in vacuo*—the ether may be disliked, just as Newton disliked the introduction of vague and ill understood causes, preferring to have none at all to account for action at a distance rather than some entity of which he neither knew nor could assert anything Electricity and magnetism were a sealed book then, and Clerk Maxwell was far in the future

There are, however, sciences of which the working hypotheses must be vague The mental sciences are peculiarly in that condition we cannot treat of mind in any quantitative manner The trivial details of experimental psychology skirt about the fringe of the subject, collecting data rather like those of old fashioned meteorology, in the hope that perhaps some day a comprehensive generalisation will arise which can reduce them to law and order

All this preliminary is for the purpose of (perhaps unnecessarily) insisting that science exists in many stages of development and that we are not at liberty to turn down a nascent science merely because it is still in an infantile and unmetrical or even a capricious condition Human activities cannot be denied merely because they are inaccessible to calculation and defy prediction

To take an extreme example What is called the spiritistic hypothesis is flagrantly objected to, for it appeals to the activities of unknown agencies which cannot at present be satisfactorily brought to book The supposed agents have human characteristics, and behave as if they were like ourselves, except that they are for the most part out of touch with matter, save under special conditions which it is our business to investigate if we can whereas we ourselves, when acting as agents, are not only conscious mental and spiritual entities, but are closely and continuously in touch with matter for a period of the order of a century Our action on matter makes our behaviour conspicuous and easy to observe, but it has not yet led to any explanation The connexion between mind and matter is still an unsolved problem, the mechanism of it is only very partially understood—the link between mind and brain is missing,—but that does not prevent our accepting the activities of, say, engineers and architects and artists as a fact They do deal with matter, in accordance with their plans and designs, whether we understand the process or not

So if hereafter we find ourselves still existing and active, after we have escaped from our normal organism,—if it turn out that under certain conditions we are able to use the organisms of others, so as still to affect material particles, especially the complex molecules of living protoplasm, and thus display surviving intelligence,—we should hope to be met, not by an *a priori* objection as to the possibility of such activity, but rather by a willingness to study the evidence and a determination to be guided by the facts, as in any other better established and more reputable branch of inquiry

Still, it does happen that even after some prolonged and impartial study of the facts, the hypothesis of what may be called posthumous activity is still disliked and still provisionally rejected as an attempt at explanation For example, my distinguished friend, Charles Richet, accepts all the phenomena that I do, or even more, but the tentative explanation of some of them as due to discarnate activity does not appeal to him or perhaps I should rather say is only very gradually beginning to appeal to him And there are other less well known members of the Society for Psychical Research who stand out against the spiritistic view and strive after every other sort of explanation,—thereby doing good service and constraining a supporter of the hypothesis to bring forward constantly better and better evidence and to realise more clearly the objections that have to be met

Again, I suspect that contributors to Nature, and the majority of its readers regard both the hypothesis and the phenomena which led to it with serious doubt and unconcealed dislike some indeed pour contempt on the whole thing as a savage superstition But the occurrence of the phenomena amid all races and in all periods though it may arouse prejudice is no valid argument against the reality of something responsible for those widespread superstitions Our business is to disentangle them from superstition and to dissect out whatever element of truth they may enshrine For it has been our experience that an element of truth often does underlie old legends Explorers often discover that old beliefs had a foundation after all witness Schliemann at Troy, Sir Arthur Evans at Crete and many other examples known to archæologists and palæographers An ancient belief can scarcely give any appreciable support to a scientific hypothesis but the existence of such belief is not really injurious and is by no means fatal to it On the whole, the existence of a tradition is rather favourable than otherwise At worst it is neutral

Objections to the Spiritualistic Hypothesis from a Scientific Point of View

With this preliminary let me comment on a sentence extracted from a paper which will shortly appear in the *Proceedings of the Society for Psychical Research*, in which an automatic writer who himself has produced script purporting to be inspired by a fairly recently deceased and comparatively unknown poet, expresses himself as sceptical about the ostensible and superficial significance of the scripts in the following words —

> " Regarded as a scientific working hypothesis, spiritism does not seem to me to be a very hopeful avenue of investigation The spirit hypothesis has a delusive appearance of simplicity, but so also had Kepler s hypothesis of guiding angels And how remote this was from the complex reality of Einstein's description of gravitation! In fact, if these supernormal mental phenomena depend on the whims and caprices of departed spirits, then I for one despair of ever being able to discover any law and order in them "

Undoubtedly there is some difficulty, in our present state of comparative ignorance, about specifying or formulating the spiritistic hypothesis in any precise and, so to speak, scientific manner, for it is an appeal to the activity of unknown agents acting by unknown methods, under conditions of which we have no experience, and by means of which we are unaware We get into touch, or appear to get into touch, with these agencies only when they have affected material objects, for example the brain, so as to produce results which appeal to our normal senses But the admission that we cannot understand how agents work does not justify our denial of the existence of such working As I have already hinted, a good deal of modern mathematical physics is in the same predicament We do not really understand how the properties of the ether, or of what it is now the fashion to call 'space time,' act in producing the material effect we call weight or gravitation We know a good deal about it, we can specify with precision the law of 'weight' in so far as it imitates the resultant of an independent and unscreened attraction of every particle for every other We can say that the earth acts nearly as if its whole mass were concentrated at its centre, that the law of force is different inside and outside, so that it changes abruptly when the surface is penetrated, and that the force attains a peak value at the surface, sloping down differently on the two sides We can speak of the state of strain or 'potential' to which the force is due, say that it is continuous across the boundary, give the law of its variation with distance, and so on

Newton, in fact, correctly formulated the whole theory of gravitation considered as action at a distance but the true mechanism of what seems like a condition of strain or warp in space, brought about by the very existence of matter, was beyond him, as it is still beyond us In philosophic mood, Newton was never satisfied with his mode of specification It merely gave the resulting effect of something that simulated the direct attraction of one body on another across apparently empty space, he had to leave the inner meaning of such mysterious action for future discovery

Einstein discarded the attraction or force exerted by a body at a distance, and replaced it by a geometry of space which would account for, or at least express, the resulting behaviour in a more intimate and, so to speak, less magical manner An inert body can only be perturbed or guided by something in immediate contact with it, even though the particular modification of that 'something,' which enables it so to act, may be due to the neighbourhood of a distant mass of matter, for reasons which remain to be explored

The fact that we sometimes have to postulate an unknown agency does not justify our attributing anything capricious to that agency We are ignorant of how the gravitational agent acts, but we know that it acts in accordance with law and order, so that the results can be duly predicted Einstein's view (if we may call it Einstein's, though in one form or another it must have been vaguely held by many) is after all *not* so very different from Kepler's asserted hypothesis What Kepler meant by "guiding angels controlling the planets" (assuming that he used that phrase) I do not know, but I am sure he meant nothing capricious He must have meant that an unknown something guided the planets in their path, and that is a paraphrase of the modern view The 'something' is now often spoken of as a warp in space In so far as Kepler postulated something in immediate touch with a planet and acting directly on it, he had what now appears to be truth on his side, his thesis being perhaps nearer the ultimate truth, though far less practically useful, than Newton's delightfully simple quantitative expression for the indirect action of a distant body

In order to illustrate direct guidance by contact action, we might take the familiar example of a gramophone needle, which automatically reproduces a prearranged tune, simply by following the path of least resistance What else, after all, can an inert thing do? That is the meaning of inertia Animated things are not inert, they need not take the easiest path A man may climb the Matterhorn for fun But inanimate unstimulated matter never behaves with any initiative or spontaneity, it is strictly inert Atoms never err or make mistakes, they are absolutely law abiding If they make an apparent error, if a locomotive engine leaves its track, we call it a catastrophe All machinery works on that principle every portion takes the easiest path It is true that to get a coherent result there must have been planning and prearrangement Certainly! In all cases of automatic working, whether biological or other, that must be an inevitable preliminary But explorers of the mechanism will detect no signs of mental action by their instruments or their senses To infer a determining or controlling cause they must philosophise Indeed, we may go a step further, and emerge from the past into the present, thus A wireless set talks like a gramophone, and to one accustomed only to gramophones it would seem barbarously superstitious to urge that in the wireless case some (possibly whimsical and capricious) operator was actually in control Statements may be unpalatable, and yet be true

Now return to gravitation Planets behave as if they were attracted by the sun That is certainly true But what is attraction? A train is not attracted to its destination lightning is not attracted to a chimney, but it gets there none the less, by continually taking the easiest path So it is with a planet Indeed, one might say that everything inert takes the only path open to it, it has no option The law is a sort of truism But the principle, once recognised, has been formulated into a clue the Principle of Least Action can be expressed mathematically Once postulate that, and the behaviour of the inanimate portions of the cosmos can be accurately deduced

The modern statement that the planets move along the line of least resistance, or the easiest path, makes their motion rather closely analogous to that of a railway train guided by the rails The path and destination of a train are determined by the

continual direct influence of the rails, which make it easier for the train to travel in the right direction than to jump them and go astray We might, if we chose, admit that the path was laid down or determined by the mentality of the surveyors and designers of the route, but a Martian spectator with partial information might still wonder at the apparent intelligence which guided one part of a train to Manchester, and another part to Liverpool, in accordance with the wishes of the passengers or the labels on the coaches If told that an invisible guardian angel switched over the points to produce this result, he might resent the suggestion as absurdly unscientific and preposterous, as on a purely mechanistic view it would be

After having studied trains for some time, our spectator might begin to notice the novelty of a motor car His first tendency would be to look for the rails in that case also, and, finding none, he might superstitiously but correctly surmise that a guardian spirit was guiding the car to its destination In this case, moreover, further experience would soon persuade him that he had to allow for an element of caprice But even that is not fatal to the truth he need not throw up his hands in despair As soon as we introduce the activity of life and mind we get out of mere mechanism, and the results are not easily formulated or predicted The activities of an animal cannot be expressed in mathematical terms, and yet animal instincts and behaviour are subject matter for scientific investigation It is assumed that they obey laws of some kind

Science is not limited to the accurate data and laws of mathematical physics and to claim that a hypothesis is unscientific because we cannot formulate it completely, or because we do not understood the method of working, or even because there is a certain amount of capriciousness about it, is more than we have any right to claim Anthropology and sociology are less advanced sciences than physics and chemistry, they have to get on as best they can, with a profusion of data, and with the inevitable complications appropriate to live things Let us not be put out of our stride by the fear of retaining, in modified form, some of the animistic guesses of primitive man Experience may lead us, as it led him, to contemplate stranger modes of existence, and more whimsical phenomena, than our long study of mechanism has led us to expect We must put aside prejudice, be guided by the evidence, and strive for truth The superficial simplicity of materialism has served us well, as a comprehensive covering, for three centuries, and we have made good progress under its protection, but it is beginning to be threadbare and inadequate, it is not co extensive with reality, and unsuspected influences are peeping through

To sum up A working hypothesis can be followed and developed rationally, without being metrically exact in its early stages The important question about the spiritistic hypothesis is not whether it is simple or complicated, easy or puzzling, attractive or repellent, but whether it is true Its truth can be sustained or demolished only by the continued careful critical and cautious method of inquiry initiated by the S P R under the presidency of a guiding spirit or guardian angel called Henry Sidgwick, with the active (and I believe continuing) co operation of Edmund Gurney and Frederic Myers

The Supply and Therapeutic Uses of Radium

By Prof S Russ, The Middlesex Hospital

THE law of supply and demand is as true for radium as other commodities Production has often almost ceased owing to lack of demand, only to be renewed as the demand returns, while sudden demands have sent up the price to prohibitive levels until either competition or diminished requirement has brought it down again

The three main sources from which radium has been mined on any scale are Czechoslovakia, the United States of America, and the Belgian Congo, Cornwall and Portugal have also been producers, though on a smaller scale The low grade of the carnotite deposits in U S A made it impossible for America to compete with production from the large deposits of pitch blende located by the Union Minière du Katanga in its property in the Congo since this rich source has been developed Czechoslovakia still produces radium, and in Great Britain there is very little difference in the price of radium coming from there or from the Belgian Congo Unless the amount bought is as much as several grams, the price is at present £12 per milligram of radium element, with extra charges for certificates of measurement and other services connected with the supply This price is doubtless one which yields a very big profit to the producers, and it is worth while mentioning that the price of the Belgian radium is graded according to the national purse of the buyer—Britain pays more than do her continental neighbours, and America pays more than Britain There is radium enough in the earth for the world's needs if it can be paid for

The therapeutic uses of radium are mainly in connexion with cancer, though it is also used for certain other conditions and some dermatological diseases The outstanding medical interest in radium therapy is in determining its value and the best methods of application in the treatment of cancer

Radium therapy has gone through several phases In its earliest years, about 1900, success often attended its use in superficial cancers of low malignancy, this was followed by attempts at dealing with internal growths by implanting radium in platinum or other metal tubes into them Dominici from 1909 onwards insisted on the necessity of avoiding the use of easily absorbed beta and gamma rays when radium was actually inserted into the tissues, and said that only "les rayons ultra-pénétrants" should be used

By the year 1914 radium therapy had already made some progress The principle of selective action was recognised, and there were several laboratories where the effects of the rays on normal and malignant structures were being investigated All this work received a set back during the years of the War, but the ten years that have passed since have been a time of great activity and progress in the subject

France is the home of radium therapy (Curie thérapie they prefer to call it), and it is in no small part due to the systematic researches carried out at the Institut du Radium in Paris, organised by Prof Regaud, that radium therapy has reached its present phase This phase is one in which the definite gains of the past give rise to the belief that radium may be looked upon as a means where by certain localised growths of cancer can be removed as surely as, and generally with less danger than, by surgery This is a big claim, and it is one now generally acknowledged, but it can not seriously be suggested that radium is a cure for generalised cancer Although a primary local ised growth often disappears with radium treatment, in cases where the disease has already spread to glands it is generally true to say that the disappear ance of growth in one part of the body has little recognisable effect upon the spread of the disease outside the range of action of the radium

One of the most important principles that has been recognised during the last five or six years is the significance of the time factor It is certain that the effect of radiation upon a tumour depends not only upon the dose of radiation absorbed by the tumour and the surrounding normal structures, but also upon the time over which the radiation is spread This is nowhere exemplified better than in the treatment of cancer of the tongue For many years these growths, often heavily infected with bacteria, were the despair of those who attempted to treat them by inserting one or two radium tubes, containing perhaps as much as 50 milligrams of the element, and leaving them *in situ* for twenty four hours With this treatment it often happened that the local condition was actually aggravated Since the treatment has been altered and a number of smaller tubes containing only a milligram or two have been inserted and allowed to remain for a week or ten days, so great has been the improvement in the results that, to day, radium combined with surgery is looked upon as the most suitable treatment for cancer of the tongue and buccal cavity

An explanation of this difference in biological reaction has been sought on various lines, for while some think that it lies in the greater probability of cells in the vulnerable state of division being ir radiated in the longer exposure, others believe that cell growth is more affected by prolonged than by short period irradiations, while the opinion is also held that the effect is largely due to the ability of the host to support a low intensity of radiation more easily than a high one It must not be lost sight of, however, that the two types of treatment are fundamentally different in the distribution of the radium in the tissues In the second case the radiation of the region involved is much more uniform and there is more prospect of treating the whole of the growth than in the first case, where one or two tubes containing a large quantity of radium are embedded This distribution necessarily gives a much too heavy dose to the tissues surround ing the tube, while at the same time much of the growth may be outside the lethal range of action

Radium is now an acknowledged agent in the treatment of localised cancer, and every year new methods are being devised in order to deal with the more inaccessible varieties of growths (for example, stomach, œsophagus, brain, etc) But the radium in Great Britain is not enough to treat the numbers of cases of cancer who would probably benefit from its use It is true that the supplies, especially in the London area, have been considerably increased in the last five years, but in Great Britain generally there is a real shortage From a national point of view, if an agent is known to be of remedial value in the treatment of any disease then it would naturally be urged that it should be got, provided there are people enough who know how to use it to the best advantage These two objects are doubtless in the minds of those who have not only to gauge the nation s radium needs but also to find the means of satisfying them It is unthinkable that Great Britain cannot really afford the radium that it requires, but the administration of a quantity, let us say a gram per million of popula tion, calls for a good deal of consideration in medical economics Is the present moment the time for starting a radium centre on the broadest lines where treatment, research, and the teaching of therapy can be carried out ? Would it be better to supple ment the resources of centres in Great Britain which have already earned a certain reputation ? Or would it be better to aim at putting the tech nique of radium therapy into the hands of the general practitioners of the country ?

The final result, in so far as the economic and efficient treatment of cancer by radium is con cerned, is very largely bound up with the decisions of a national character which are likely to be taken in the near future

In the House of Commons on April 16, Mr Winston Churchill announced that the Govern ment has arranged for the publication of the report of the Sub Committee of the Committee of Civil Research on Radium This Sub Committee under the chairmanship of Lord Rayleigh, expressed the opinion that in order to meet the medical require ments of England, Scotland, and Wales twenty grams of radium should be acquired before the end of 1930 It also recommended the election of 'National Radium Trustees' whose duty it should be to hold the funds provided and to purchase and hold radium for the use of an expert body, this expert body to be called the 'Radium Commission' Mr Churchill further stated that the Government has accepted the financial recommendation of the Sub Committee and that it will be prepared to con tribute from public funds, up to a maximum of £100,000, to the extent of £1 for every £1 of private subscription

Obituary.

Sir George Knibbs, C M G

BY the death of Sir George Handley Knibbs at Melbourne, on Mar 30, science in Australia has lost one of her most forceful and enthusiastic workers

Sir George was born in Sydney in June 1858 As a surveyor and civil engineer he took an active part in the topographical survey of New South Wales He then became acting professor of physics at the University of Sydney In 1906 he was appointed Commonwealth Statistician, and in that capacity brought out the Commonwealth Year Book, which, by reason of its comprehensive and accurate nature, is one of the best statistical publications in the world

After serving for fifteen years as Commonwealth Statistician, Sir George Knibbs was appointed in 1921 Director of the Commonwealth Institute of Science and Industry, which post he held until his retirement from public life in 1926 The Institute was then reconstructed as the Council for Scientific and Industrial Research While under his direction, the small staff of the Institute commenced a number of important lines of investigation, some of which have recently passed from success in the laboratory to the sphere of commercial scale tests These included research into the manufacture of paper pulp from Australian hardwoods, power alcohol production, the eradication of prickly pear, and the utilisation of Australian pottery clays Knibbs deplored the inevitable whittling away of funds intended for research purposes, due to political indifference, which lessened the value of the Institute to the nation The constitution of the Institute, however, did not favour its fullest co operation with the universities and other State bodies, nor did the somewhat autocratic manner of the director attract his Australian fellow scientific workers Both features were undesirable in a national research body

Throughout his public life Sir George Knibbs took an active part in social legislation and served on Royal Commissions concerned with education, social and other forms of insurance, taxation of crown leaseholds, trade, and industry As Commonwealth Statistician, he devised the mathematical formulæ on which the Commonwealth land and income taxes are assessed

Though his activities were more of an administrative nature, Sir George contributed to the scientific press numerous monographs on pure mathematics, geodesy, and geodetic instruments His larger contributions include "The Mathematical Theory of Population," "The Census of Wealth," and a recent book, "The Shadow of the World's Future"—a study of the relation of world population growth to food production and migration influences From a statistical basis, he emphasises the need for modification in national policies to avert the danger of over population

Sir George Knibbs was a fellow of the Royal Astronomical Society, an honorary fellow of the Statistical Society, and a member of the International Institute of Statisticians He attended many international congresses, where his sound knowledge of foreign languages, backed by a comprehensive grasp of scientific affairs, made him an able and worthy representative of the Commonwealth Although in recent years his health was failing, this disability seems to have had little effect on the keenness and brilliance which he applied to the welfare of Australian scientific organisations The knighthood bestowed on him in 1923 was regarded in Australia as a fitting recognition of the devoted and brilliant service he had rendered to his country

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Sir Henry Rew, K C B

The death at his house at Wormshill, Kent, on April 7, at the age of seventy years, of Sir Henry Rew removes a leading authority on agricultural economics and, in the old sense of the word, statistics For some years prior to 1906 he was in charge of the Statistical Branch of the Ministry of Agriculture and Fisheries, and after his promotion in that year to the post of assistant secretary, his predominant interest lay in the annual reports on agricultural statistics, for which he was personally responsible To his work in this field is largely due the fullness and comparability of the series of returns on British agriculture His initiative may be exemplified by the estimates made by a committee of the Royal Statistical Society, from returns from representative dairies and slaughter houses of the production of milk and meat in the British Isles

The two addresses given by Sir Henry Rew as president of the Royal Statistical Society were devoted to "The Organisation of Statistics" and to "The Progress of British Agriculture" In the first of these he emphasised that 'The real question is not the present defects of the official statistics or the delinquencies of official statisticians, but the deficiencies of the present system and the inadequacy of the available resources" After quoting the several high authorities who at different times had urged the importance of the establishment of a centralised statistical department, he expressed his own conviction of the need for "a general overhaul of official statistical machinery, and for some drastic measure for securing co ordination" The function of the Royal Statistical Society should be to assist in forming an appreciative, watchful, and well informed public opinion

Sir Henry's second address to the Royal Statistical Society was largely a historical account of agricultural statistics leading to the important conclusion that while the statistical data were unable to prove the case, an examination of the statistics so far as they were available pointed to the conclusion that a larger quantity of food was being produced at the outbreak of War than at any previous period, and this in spite of a shrinking acreage

MR C E BENHAM

MR CHARLES EDWIN BENHAM, of Colchester, whose sudden death on April 1, at sixty eight years of age, we regret to record, was a representative of the type of scientific amateur of which British science has reason to be proud He followed scientific pursuits, and studied natural processes and events, purely for the love of Nature in all her ways, and by faithful observation and original mind he was able to make some notable contributions to knowledge

Mr Benham was for many years editor of the *Essex County Standard* and spent most of his life in the town of Colchester, where he took a leading part in educational and other movements It is not surprising that "William Gilbert of Colchester" should have attracted his literary and scientific attention, for Mr Benham's methods were of the same experimental and independent character as those of Queen Elizabeth's learned physician In an excellent little book published in 1902 he showed what manner of man Gilbert was, wherein lay his genius, and the spirit of his work which was "that all scientific knowledge must be founded on practical experiment and observation alone, instead of upon speculations and theories evolved out of inner consciousness"

In 1895 Mr Benham devised a colour top by which a curious optical illusion is produced which is not easy to explain Half of a white cardboard disc is coloured black and on the other half a number of black lines are drawn as arcs of a circle On rotating the disc, and viewing it in a bright light, the arcs of some of the circles appear coloured On reversing the rotation the order of the colours reverses The subjective colour effects then exhibited were the subject of a number of letters in NATURE at the time the top was produced, and Mr Shelford Bidwell devoted a paper to them which was published in the *Proceedings of the Royal Society* of Dec 17, 1896

On the experimental side also, Mr Benham developed the twin elliptic pendulum and published a number of papers on harmonic vibrations and vibration figures He was the author of many communications published in NATURE, *Knowledge*, *Science Progress*, *Engineering*, and other scientific journals, and the subjects covered a wide range of practical inquiry, including thermographs, atmospheric electricity, electroscopes, alarum sundials, and iridescent glass Mr Benham was in addition an artist whose water colour drawings are of real distinction, and the author of works on local Essex dialects and the history of Colchester He was an ardent lover of knowledge in all its highest aspects, and his death will be regretted by a wide circle of students who have been stimulated by his work, as well as by his numerous personal friends

PROF F KEHRMANN

DR FRIEDRICH KEHRMANN, professor of organic chemistry at the University of Lausanne, died on Mar 4 We are indebted to the *Chemiker Zeitung* for the following details of his career Born at Coblenz in 1864, Kehrmann became deeply interested in chemistry while still a boy, but being at first unable through lack of means to attend regular classes, he studied by himself He became so proficient in analytical work that he obtained a post as analytical assistant to Fresenius at Bonn In 1887 he graduated at Basel under Nietzki, with whom he carried out an investigation of quinones After graduation he became assistant to Claus at Freiburg, where from his observations upon di ortho substituted quinones he formulated the well known hypothesis of 'steric hindrance,' a generalisation which has been very extensively applied in the study of other branches of organic chemistry

Kehrmann's hypothesis was based upon the hindering effect of two ortho substituents upon oxime formation, and in support of his idea he quoted many other well known examples of inhibited reactions, which had hitherto remained unexplained He was even able to foresee the discovery of steric hindrance in the ortho substituted benzoic acids This prediction was verified shortly afterwards by the work of V Meyer but for some reason or other Kehrmann's claim to priority seems to have been overlooked

Kehrmann moved to Aix le Chapelle and thence to Geneva, where he found in Graebe's laboratory a congenial atmosphere and inspiring companions At Geneva his chief interest was in dyestuff chemistry, to which he made many notable contributions, particularly in the field of azines thio azines, and oxazines To him may also be attributed the origin of the theory of the oxonium salts For a short time he held a post with the firm of Casella and Co, but ill health compelled him to relinquish it Later he took up a teaching appointment at the Municipal School of Chemistry at Mulhausen in Alsace, and in 1910 he was appointed to the chair of chemistry at Lausanne His collected works, which include the spectroscopic examination of whole classes of dyestuffs, have been published in five volumes

WE regret to announce the following deaths

Mr W Worby Beaumont, honorary consulting engineer of the Royal Automobile Club, for ten years a joint editor of *The Engineer* and author of several well known books on motor car engineering, on April 14, aged eighty years

Prof F S Earle, sugar cane technologist at the Tropical Plant Research Foundation at Herradura, Cuba, and president in 1906 of the American Botanical Society, on Jan 31, aged seventy two years

Mr Charles Hunt, an honorary member and past president of the Institution of Gas Engineers, aged eighty six years

Prof Clemens von Pirquet, professor of pædiatrics in the University of Vienna, known for his studies of the mathematical relationship of body measurements to nutritional requirements and for his cutaneous tuberculin reaction, aged fifty four years

Dr Paul Sarasin, president of the ethnographical section of the Natural History Museum of Basle, on April 7, aged seventy three years

News and Views.

Sir Alfred Ewing, Principal and Vice Chancellor of the University of Edinburgh, was presented on April 18 with the freedom of the City of Edinburgh in the Usher Hall in the presence of a large and representative assembly The honour was conferred, as stated in the Burgess Ticket, as a mark 'of the high esteem in which he is held by the citizens of Edinburgh, in testimony of his valuable services to the city and the State, and in recognition of his brilliant and distinguished career as Principal of the University of Edinburgh during a period marked by exceptional difficulty on account of the War and the policy of unprecedented development and expansion of the University The Lord Provost, Sir Alexander Stevenson, who presented the silver casket containing the Burgess Ticket, spoke of Sir Alfred's distinguished career of his services to the University and his efforts to make the University a living force in the City, and of his work at the Admiralty during the War as creator and organiser of the department which achieved great success in intercepting and deciphering enemy wireless messages In his reply Sir Alfred referred to some of the important developments in the University during the thirteen years of his principalship, and at the end stated that he had received from Sir Alexander Grant a cheque for £25 000 and a promise of a like amount within twelve months for the building of a new department of geology After the ceremony, Sir Alfred accompanied by the president of the Students Representative Council, was conveyed from the Usher Hall by way of Princes Street to the City Chambers in a gaily decorated open carriage drawn by students

In 1923 a large wooden building which was erected in 1917 in St Andrew Square, Edinburgh for the use of American troops, was purchased by the University and rebuilt on the new campus near the southern edge of the City adjacent to the Department of Chemistry Early in the following year the Department of Geology was transferred thereto from inadequate premises in the Old College The wooden building is now approaching the limit of its existence, and Sir Alexander Grant s generous gift relieves an anxiety which was becoming acute as to the housing of the Department of Geology This is the second benefaction the University has received from him, for about four years ago he contributed a sum of £50 000 towards the extinction of the debt on the Department of Chemistry In June 1923 he gave £100,000 towards an endowment fund for the Scottish National Library, and in July of last year a further sum of £100,000 for the erection of a suitable building in which to house the Library He was also one of the chief contributors to the fund for the Scottish National War Memorial His name, as Sir Alfred Ewing said is in Edinburgh a synonym for generosity

When a journal has been for thirty years in charge of one man, the reputation of the journal reflects the merits of the editor The case in point is that of *The Mathematical Gazette* and Mr W J Greenstreet Founded and maintained in the interests of school teachers, the *Gazette* has pedagogy in plenty, abundant notes on scholarship mathematics, and reviews which endeavour conscientiously to appraise schoolbooks as they issue in bewildering streams from the publishers But it aims also at helping its readers to understand how mathematics has grown since their own university days, and nowhere are important mathematical treatises subjected to more valuable analysis or more authoritative criticism Keynes has been reviewed by Russell, Eddington by Newall, Weierstrass by Carathéodory, Schrodinger by Fowler, Knopp by Bromwich While Mr Greenstreet has secured for a journal which grew out of the annual reports of a teachers' association the standing implied by such names as these, he has also poured into its pages a wealth of biographical and historical knowledge which has made the *Gazette* the most readable mathematical periodical in the world A testimonial in appreciation of Mr Greenstreet's long and successful editorship has been organised by the Council of the Mathematical Association, which invites the co operation of everyone who feels that such work as his deserves recognition Because of a severe illness which drained his resources two years ago, the testimonial is to take the form of a cheque, accompanied by the names of subscribers but not by a list of amounts The expenses of the fund are being borne by the Mathematical Association, and the work involved has been undertaken by Mr C Pendlebury, 39 Burlington Road, Chiswick, London, W 4, to whom donations should be sent

The pioneers of New Zealand geology include von Haast, James Hector, F W Hutton, and Ferdinand von Hochstetter, the last of whom was born on April 30 1829 The son of an Austrian pastor, Hochstetter took the degree of Ph D and in 1853 joined the Geological Survey of Austria Four years later he became geologist to the famous *Novara* Expedition and on Dec 22, 1858, arrived at Auckland, where his services were at once secured by the Government Von Haast, the German geologist, had arrived the day before, having been sent out to report on the suitability of the country for German emigrants Together, Haast and Hochstetter carried out extensive geological explorations and both published works on the geology of New Zealand Returning to Europe in 1861, Hochstetter settled at Vienna and for many years held the chair of geology and mineralogy at the University there He died on July 21, 1884, and a memoir of him was written by Haast, which was reviewed in our columns on Nov 20, 1884

Prof E V Appleton, Wheatstone professor of physics at King's College, London, has been awarded the Morris Liebmann Memorial Prize for 1929 by the American Institute of Radio Engineers This prize is awarded annually by the board of directors of the Institute to the worker responsible for the most important contribution made to wireless progress during the preceding year Prof Appleton has for

some years been engaged in the study of the scientific problems of radio telephony, chiefly on behalf of the Radio Research Board and the Department of Scientific and Industrial Research In 1924, working in conjunction with Dr Barnett, he was the first to put forward acceptable experimental evidence for the existence of the so called Heaviside layer and the value of its height above the ground More recently, work on similar lines has been carried out under Prof Appleton's direction, in the most part at the Peterborough Station of the Radio Research Board and at King's College, London, where wireless methods have been developed which have led to a great increase in our knowledge of the electrical properties of the upper atmosphere It may be recalled also that Prof Appleton made an announcement in NATURE of Mar 23 last, of the discovery of what is probably a second Heaviside layer He was recently awarded a Wireless Premium by the British Institution of Electrical Engineers for his researches on the causes of wireless signal fading and directional errors

A MOVEMENT to commemorate in an appropriate way the pioneer work of the late Mr W H Dines in the exploration of the upper air and in other branches of practical meteorology was initiated a few months ago by the Royal Meteorological Society The Council of the Society believes that the most suitable form of memorial would be the publication of a collection of Mr Dines's scientific papers in a single volume, and a circular has just been issued inviting promises of subscription to such a volume of about 600 large octavo pages, to be published at a price not exceeding thirty shillings The papers consist almost exclusively of contributions to the publications of a number of scientific societies extending over a period of fifty years , and their re issue in a collected form would not only be a tribute to Mr Dines's original and fruitful work but also would be of real service to science in general and students of meteorology in particular Intending subscribers to the volume should communicate with the secretary of the Royal Meteorological Society, 49 Cromwell Road, South Kensington, S W 7 We trust that the promises to purchase the volume when published will be numerous enough to relieve the Council of any anxiety which may be involved in the cost of publication of a work worthy of one whose researches began a new epoch in the history of meteorology and have led to developments of great practical value

THE American Association for the Advancement of Science held a very successful meeting in New York during the last week of December On behalf of the fifty educational and scientific organisations of the city, Prof Henry Fairfield Osborn, the president, welcomed the Association, which now includes more than 17,000 members, and gave an indication of the programme set for the meeting A reprint of his address has now reached us The programme seems to have been arranged with great regard to the convenience of the public and the scientific worker of wide interests, for separate days were set aside for general sessions each on one particular science, so that geology, physics, biology, chemistry, and anthropology each had its day, and on the evening of the same day a reception and address followed in the corresponding department of the American Museum of Natural History Following the excellent precedent of the British Association, these evening addresses were of a semi popular character designed to attract and stimulate the rapidly growing interest in science manifested in the city of New York and throughout the United States and Canada "The leading *motif* of this science week programme was to offset some of the extreme specialisation of the present day by a more general prospectus of the unity and harmony of various sciences such as prevailed in the unified spirit of the great founders of the Association eighty five years ago " It is a leading *motif* which deserves serious consideration in arranging the programme of the British Association Advantage was taken of the occasion of the meeting to celebrate the centenary of the epoch making glacial theory of Louis Agassiz, one afternoon session being devoted to a symposium of addresses on various aspects of glaciation

ONE of the interesting evening addresses was delivered by Prof W M Wheeler, of Harvard University, on "Present Tendencies in Biological Theory," and this has since appeared in the February *Scientific Monthly* Prof Wheeler makes a strong protest against the critics of biological theory, who find that "biology has been steadily going to the dogs ever since the Renaissance," or that "biology has about reached a stage corresponding with pre Copernican astronomy and physics, and that biologists have not yet discovered a single law, since what they have been fondly calling laws are merely rules or generalisations" He considers that there are at least three recent theories, which, with some mutual adjustment, might yield a provisional synthesis, or at any rate clarify the conflict between the mechanistic and vitalistic points of view These are the theory of emergence or 'holism' propounded by Prof S Alexander, Prof C Lloyd Morgan, and General J C Smuts , the configuration or 'Gestalt' theory , and behaviourism Each of these theories deals with wholes, from different aspects , the first emphasising that the whole has a novel import not apparent in any mere sum or aggregate , the second being more interested in the peculiar irreducibility of wholes as patterns either in space or time than in their novelty , and the third concerned with the action patterns of the whole organism in response to its environment While admitting that certain oppositions must remain in biological theory from the nature of the emergence levels of organisms, Prof Wheeler thinks that many of the oppositions among theories may be elucidated and toned down "by the rejection of a lot of adventitious and mystical notions foisted upon the biological sciences by historians and philosophers "

AN outstanding feature in the recent history of the British Research Association for the Woollen and Worsted Industries is the retirement of the chairman, Sir James P Hinchliffe Sir James, who is well known for his public services in Yorkshire, is a

distinguished figure in the textile industry, and he has, in large measure, been responsible for the development of the present high degree of efficiency of the Association He is succeeded by Lord Barnby, who, in addition to being governing director of one of the largest wool firms in the world, has already rendered much service through the Federation of British Industries and elsewhere, by his advocacy of the importance of the application of scientific method in the development of British industry The Report of the Association for the year 1928–29 contains a complete survey of its activities The effects of selection, breeding, nutrition, climate, and pasturage on particular breeds of sheep, and the consequent effects upon the wool produced, are being investigated, with the financial assistance of the Empire Marketing Board, in conjunction with the Dominions overseas Physical and chemical problems continue to provide an extensive field of investigation Much of this work has already been described in previous reports by the Association The joint research with the Society of Dyers and Colourists upon fastness of dyestuffs and fading of fabrics due to light, perspiration, and other agents, is being continued

The extent and complexity of the purely scientific problems which confront the textile industry at the present time are clearly described in the Report referred to above, and the difficulty of the dissemination of the results of the purely scientific work of the Association in the industry itself has received timely emphasis The better utilisation of research, not merely in the textile industry, but also in British industry generally, is probably one of the most urgent needs of the present time The final Report of Sir Arthur Balfour's Committee on Industry and Trade sounds a warning note upon this point when it states that before British industries, taken as a whole, can hope to reap from scientific research the full advantage which it appears to yield to some of their most formidable trade rivals, nothing less than a revolution is needed in their general outlook on science , and in the case of some industries at least this change of attitude is bound to be slow and difficult, in view of old and deeply rooted industrial traditions The work of the research associations generally will be immensely facilitated if this view gains a wider appreciation amongst all those engaged in industry to day

In his Friday evening discourse, delivered on April 19 at the Royal Institution, Prof O T Jones described a visit to the Grand Canyon, Yellowstone National Park, last summer This is the largest of the national parks in the United States, and is chiefly remarkable for its geological and physiographical features Volcanic accumulations of the Tertiary period make up a large area of the Park and attain a thickness of many thousands of feet The large number of existing geysers and hot springs indicates that the volcanic phenomena are not yet quite extinct Among the most striking of the physiographic features of the area is the great canyon carved by the Yellowstone River on its way from the Yellowstone Lake to join the Missouri Physiographers have usually regarded the Grand Canyon as a product of erosion since the glacial period An examination of sediments in the wall of the Canyon near the Great Fall has shown that they are sands, muds, and conglomerates extending in different places from the rim of the Canyon nearly to the bottom These prove beyond doubt that the Canyon since its excavation has been dammed at some point below, and in the lakes resulting from this process the sediments have accumulated, filling the Canyon to the brim Further investigations have established that the Canyon since its excavation has been dammed by great flows of lava which entered the Canyon from the north and flowed against the drainage of the Yellowstone and its main tributary, the Lamar River A consideration of the profiles of the drainage system shows that prior to the damming episode the Canyon had been eroded in three or four stages or cycles of erosion , each new stage being initiated by uplift of the region The lava flows entered the Canyon while the last cycle of erosion was in progress The results of these discoveries have thrown an entirely new light on the volcanic history of the Park, which will have to be examined anew

The Society for Experimental Biology met at the University of Manchester on April 19 and 20, the meetings being held in the Physiology Department through the kindness of Prof H S Raper Among the numerous contributions were an account of the growth and development of different types of bulbs by Prof F E Weiss, and a stimulating discussion which followed the statement, by Prof D Thoday, of the principles underlying the causal interpretation of plant anatomy Mr M A H Tincker described the effect of varying the daily light duration upon the time of flowering, form, and chemical composition of plants, while Mr E J Collins outlined some experiments on the 'breaking' of tulips Prof H S Raper gave an account of melanin formation among animals, pointing out that a similar mechanism appears to underlie all the cases explored, with possible exceptions among vertebrates Mr J Needham discussed the evolution of the egg and the metabolic limitations which it imposed upon the embryo Prof T H Pear described his work upon the transfer of training in the acquisition of manual dexterity Mr A D Ritchie introduced an interesting discussion on the acid base equilibrium in muscle

The Prime Minister of the Commonwealth has appointed a committee to take charge of the general arrangements for the proposed Australian Antarctic Expedition under Sir Douglas Mawson Sir George Pearce, vice president of the Executive Council, is chairman of the committee, and the other members are Sir Douglas Mawson (or, in his absence, Capt J K Davis, who will be second in command of the expedition), Sir David Masson, Rear Admiral W R Napier, Dr A C D Rivett, and Dr W Henderson The expedition will undertake a coastal survey of the Antarctic continent south of Australia between longitudes 160° and 45° east, the *Discovery* having been placed at its disposal by the British Government

It is anticipated that the ship's complement will number twenty six, and that the scientific staff, including a press correspondent, will be twelve The starting point of the expedition has not yet been determined, but operations will probably begin late in November and continue until the end of April 1930 It is very probable that a second season will be necessary to enable the whole programme of the survey to be carried through

In the article on Christian Huygens in our issue of April 13, p 575, reference was made to the object glass of 122 feet focal length which, according to Weld, was given to the Royal Society by Huygens in 1691 Weld also states that two other object glasses of Huygens' were afterwards presented to the Society by Sir Isaac Newton and the Rev Gilbert Burnet From Prof R A Sampson, Astronomer Royal for Scotland, we learn that the real donor of the first and the maker of all three lenses was Christian's elder brother, Constantine Huygens (1596–1687), and that, collaborating with Prof A E Conrady, Prof Sampson has recently communicated to the Royal Society a paper containing a critical account of these historical lenses Weld's "History of the Royal Society" was published in 1848, but the mistake about the lenses had been pointed out by Uylenbroek ten years before From the *Times* of April 22, we learn that the tercentenary of the birth of Huygens was celebrated the previous week at Leyden, the commemoration being organised by the Royal Academy of Sciences in conjunction with the University of Leyden and various scientific associations A souvenir account of the proceedings is to be published at Amsterdam

The issue of *Vox* for Mar 1, edited by Prof Calzia, of the University of Hamburg, contains an official communication of the International Society of Experimental Phonetics giving an account of the Conference to be held on July 24–31 next in Hamburg, with a list of addresses and demonstrations and an announcement that opportunities will be given for practical training in the methods of the science The published list of members includes experimental phoneticians from nearly every country in Europe and also from America and Asia An account of a new and very practical form of stroboscope for observing the vocal cords is illustrated in detail *Vox* is the official organ of the Phonetic Laboratory of the University of Hamburg, the Phonetic Institute of the University of Vienna, and the International Society of Experimental Phonetics It is sent without charge to members of the International Society

Dr Millais Culpin has contributed an article on noise and hearing, considered from the psychological point of view, to a recent issue of *The Nineteenth Century* (vol 105, No 626) Few of those who most volubly protest against the noises of modern life are content to base their objection on the simple fact that unnecessary noise is irritating to most people, and that certain temperaments may find that irritation harmful to health Instead, a pseudo scientific terminology is used to describe fantastic happenings to the central nervous system Dr Culpin discusses the problem of nervousness, the relation of the nervous temperament to the degree of suffering from noise, the bewildering array of personal peculiarities that confronts any investigator of noise, the domain of the physiological injury when such can be proved to exist The frequently urged view that energy is used up in ignoring noise, sounds plausible, but as it can neither be proved nor disproved it leads nowhere, arguing by analogy, however, there seems no reason to suppose that lack of attention to certain auditory sensations can be of any more danger to the organism than lack of attention to any other sensory stimulation The article is a very timely and necessary corrective to the loose thinking and over simplification characteristic of many writers on the subject Dr Culpin also makes the subject much more valuable by treating it in relation to other problems and not as an isolated phenomenon

An authoritative committee, composed principally of veterinary surgeons in charge of slaughter houses, recently held at Leeds a trial of the Weinberg casting pen, the object of which is to ensure that no suffering shall be inflicted when beasts are cast for slaughter by the Jewish method (shechita) It is therefore satisfactory to know that the report of the committee is entirely favourable The chairman was Prof F T G Hobday, principal of the Royal Veterinary College, and the honorary secretary Capt C W Hume, of the University of London Animal Welfare Society The members included Prof Lovatt Evans, five veterinary surgeons in charge of large abattoirs, and two representatives of animal protection societies It is understood that two further machines having the same object are to be tried out in the near future The subject is one upon which feeling runs very high in some slaughter houses, and in these circumstances it is not easy to ensure the scientific character of the trials by eliminating incalculable human factors The committee will doubtless, however, be fully alive to this consideration

In a recent address to the Institution of Electrical Engineers, Mr J Swinburne gave an account of Sir Joseph Swan's inventions in connexion with the carbon filament electric lamp In the April *Journal* of the I E E, Mr A Campbell Swinton has a note on the part played by Lane Fox Pitt in the invention of this lamp He thinks that neither Mr Swinburne nor Sir Ambrose Fleming in his 'personal recollections,' published in the February issue of the *Journal*, do justice to this inventor, and points out that he was the first patentee of the method of 'flashing' used in making carbon lamps, and was the inventor of the constant voltage system of public lighting with the lamps in parallel In the same journal Mr Swinburne replies that he does not know who invented the method of flashing' In his address he was discussing Swan's work, and as Swan got no help from Lane Fox Pitt's work, it was unnecessary to discuss the work of the latter He mentioned, however, in his address that Pitt did take out a patent on parallel distribution a year before Edison, which, although bad

in law, propounded with luminous clearness parallel distribution, and dispelled for ever the fog about 'the subdivision of the electric light'

AT a meeting held in the Natural History Theatre of the University of Manchester on Feb 23, a provisional committee was appointed to draw up a scheme for co-ordinating the work of the scientific societies, especially those following biological lines of research, in north-western England and Wales The committee has now issued a circular with suggestions for the establishment of a "North Western Naturalists' Union," which will, it is hoped, be definitely inaugurated in June Membership of the Union will be open to individuals as well as to societies in the area proposed, which includes the English counties from Cumberland to Staffordshire and Shropshire, North Wales, and the Isle of Man It is believed that such a Union may be of great service to the local societies, by holding a yearly general meeting and conference, by arranging exchanges of lecturers between the various centres, and by facilitating the publication of papers For many years past there has been at work a strong naturalists' union in north-east Lancashire, and it is hoped that the more comprehensive union now proposed will be a means of help and encouragement to the large number of earnest Nature lovers who pursue their studies in the busy industrial towns and the countryside of the north-west of England

THE Australian National Research Council has elected Sir Thomas Lyle, formerly professor of natural philosophy in the University of Melbourne, to the office of president in succession to the late Mr R H Cambage

AT the meeting of the London Mathematical Society on Thursday, May 16, at 5 P M at Burlington House, Prof C G Darwin, of Edinburgh, will deliver a lecture on "The Refraction and Scattering of Light" Members of other scientific societies who may be interested are invited to attend

SIR OLIVER LODGE is to deliver the nineteenth annual May Lecture before the Institute of Metals on Tuesday, May 7 The title of the lecture will be "Some Ideas about Metals" Cards of invitation to the lecture can be obtained by sending a stamped and addressed envelope to the secretary of the Institute of Metals, 36 Victoria Street, London, S W 1

IT is announced in *Science* that Prof Frank Schlesinger, director of the Yale University Observatory, has been awarded the Bruce Medal of the Astronomical Society of the Pacific for his work on photographic parallaxes and in other departments of astronomy The medal is awarded on the recommendation of the directors of the Harvard Observatory, Lick Observatory, Yerkes Observatory, the Observatory of Berlin, the Observatory of Greenwich, and the Observatory of Paris

THE Council of the Institution of Automobile Engineers has awarded the medal of the Institution to Capt J S Irving in appreciation of his brilliant work in connexion with the design of the "Golden Arrow," which, coupled with the courage and skill of Major Segrave, has resulted in the world's speed record being once more held by Britain, and this time by a very large margin The medal was established in 1922 as a recognition of technical achievement likely to have special influence on the advancement of automobile engineering

THE annual congress of the South Eastern Union of Scientific Societies will be held at the Royal Pavilion, Brighton, from Wednesday, June 5, until Saturday, June 8, inclusive, by invitation of the Brighton and Hove Natural History and Philosophical Society, and the Worshipful the Mayor and Corporation of Brighton Sir Arthur Keith has consented to serve as president in succession to Sir Martin Conway The honorary general secretary of the Congress is Mr E A Martin, 10 Avenue Road, South Norwood, S E 25, and the assistant hon secretary is Mr R W Strickland, 5/6 Clements Inn, W C 2

WE learn from a *Daily Science News Bulletin* (Science Service, Washington, D C) that the United States Senate has passed a bill providing pensions of 125 dollars per month for the Army officers and enlisted men, or their widows or heirs, who took part in 1900 in the yellow fever investigations carried out in Cuba under Major Walter Reed, which demonstrated conclusively that yellow fever is not infectious or contagious in the ordinary sense Further, the names of the 22 men (of whom 14 survive) of the expedition are to be published annually in the Army Register as a roll of honour, and each of the men or their heirs is to be presented with a commemorative gold medal

AT the annual general meeting of the Physical Society of London, held on Mar 22, the following officers were elected —*President* Dr W H Eccles, *Vice Presidents* Sir Oliver J Lodge, Sir Richard Glazebrook, Prof H L Callendar, Sir Arthur Schuster, Sir J J Thomson, Prof C Vernon Boys, Prof C H Lees, Sir William Bragg, Dr Alexander Russell, Dr F E Smith, Prof O W Richardson, Mr R W Paul, Dr J S G Thomas, Prof A O Rankine, and Prof F L Hopwood, *Hon Secretaries* Dr Ezer Griffiths and Dr Allan Ferguson, *Foreign Secretary* Prof O W Richardson, *Hon Treasurer* Mr R S Whipple, *Librarian* Mr J H Brinkworth

A PRIZE consisting of a medal and the sum of £500 is offered by the British Empire Cancer Campaign to the person, or group of persons, who shall submit the essay embodying the results of original investigations which, in the opinion of the judges, is the best contribution towards the early diagnosis of cancer The competition is open to British subjects of either sex, resident in the British Empire or the Dominions, who can obtain a copy of the rules and regulations relating to the prize by writing to the secretary of the British Empire Cancer Campaign, 19 Berkeley Street, W 1 The latest date for the receipt of essays is Dec 31, 1931 The award will be made early in the following year

AN interesting article by Prof Luigi Devoto on the results which have followed the institution of 'summer

time' appears in the *Rendiconti* of the Royal Lombardy Scientific and Literary Institute for last year This question was discussed at the seventh Italian National Congress of Industrial Medicine, held at Parma, following a paper by Prof Gaetano Pieraccini, who considered more particularly its hygienic aspects Pieraccini's conclusions, given *in extenso*, indicate whole hearted accord with daylight saving, which has resulted in the checking of various maladies favoured either by lack of light or by the use of artificial illumination

A catalogue (No 8) of miscellaneous second hand books of science, mainly of botanical and zoological interest, has been received from Mr J H Knowles, 92 Solon Road, S W 2

Readers interested in West Africa may like to have their attention directed to a short catalogue of second hand books relating to that part of the world which has recently been issued by Messrs Francis Edwards, Ltd, 83 High Street, Marylebone, W 1

Applications are invited for the following appointments, on or before the dates mentioned —A senior curator of the Museum of St Bartholomew's Medical College—The Dean of the Medical College, St Bartholomew's Hospital, E C 1 (April 29) A research studentship at St Mary's Hospital Institute of Pathology and Research—The Secretary, Institute of Pathology and Research, St Mary's Hospital, Paddington, W 2 (April 30) A lecturer in engineering, with special qualifications on the electrical side, at the Plymouth and Devonport Technical College—The Secretary for Education, Rowe Street, Plymouth (May 4) A junior scientific officer in the Admiralty Scientific Pool—The Secretary of the Admiralty (C E Branch), Whitehall, S W 1 (May 4) A lecturer in engineering at the Widnes Municipal Technical College —The Clerk to the Governors, Town Hall, Widnes (May 6) A male assistant at the Low Temperature Research Station, Cambridge—The Superintendent, Low Temperature Research Station, Cambridge (May 6) An inspector of weights and measures under the Surrey County Council—The Clerk of the Surrey County Council, Public Control Department, County Hall, Kingston upon Thames (May 6) A first assistant in the Clinical Laboratory of the Manchester Royal Infirmary—The Gen Supt and Secretary, Royal Infirmary, Manchester (May 8) A pathologist and bacteriologist at the Northern Infirmary, Inverness — The Hon Secretary, Northern Infirmary, Inverness (May 8) The Anderson lectureship in comparative psychology in the University of Aberdeen — The Secretary, University, Aberdeen (May 28) A professor of anatomy at St Bartholomew's Hospital Medical College —The Academic Registrar, University of London, S W 7 (May 30) A professor of mathematics at Canterbury College, New Zealand—The High Commissioner for New Zealand, 415 Strand, W C 2 (July 31) A junior assistant under the Directorate of Metallurgical Research, Research Department, Woolwich—The Chief Superintendent, Research Department, Woolwich, S E 18 A senior biology master at the Cambridge and County High School for Boys—The Education Secretary, County Hall, Cambridge A full time teacher of electrical engineering at the Barnsley Mining and Technical College—The Principal, Harvey Institute, Barnsley A woman biochemist at the Wellcome Physiological Research Laboratories—The Director, Wellcome Physiological Research Laboratories, Beckenham

Our Astronomical Column

Halley's Comet and the Aquarid Meteors of May 2–6 —One of the greatest of English astronomers was Edmund Halley, who acted as Astronomer Royal about two and a half centuries ago Amongst the most important of his achievements was the discovery that a bright comet visible in 1682 and first seen by an assistant of Flamsteed, revolved around the sun in about 76 years and had been observed in the years 1531 and 1607 He predicted its return in 1759, and this was realised

Since Halley's day, further investigations have elicited the fact that the comet has been in existence and visiting the sun during more than 2000 years It was last observed in 1910, and will probably reappear in about 1986 One of the occasions on which it returned was the momentous year 1066 Certain disasters and historical events were formerly connected by superstitious people with its visits

This remarkable object is the largest of all the periodical comets, and it is notable as being the source of a meteoric display which occurs during the first week in May Capt Tupman discovered it about sixty years ago, and it has been reobserved on many occasions since, though it has never furnished a really great abundance of meteors But the objects derived from this comet are unequalled in splendour and length of flight by any other meteoric display in the heavens The earth and comet do not encounter each other centrally, for their orbits at the points of nearest approach are separated by several millions of miles of space The meteors, therefore, which the earth encounters are only those placed on the outer fringe or outskirts of the system Some of the large fireballs belonging to it may possibly be observed in the morning twilight of May 2–6 next, between about 1 A M and 3 A M The conditions prevent their apparition during the earlier hours of the night

Quantitative Analysis of the Sun —Prof H N Russell contributes an interesting article on this subject to the *Scientific American* for April He gives a sketch of various stages in the history of spectroscopy The earliest stage lay in the simple recognition of the presence of various elements in the sun and stars Then followed the stages of the study of radial velocities, and of the detection of magnetic fields. Attention is now being given to the contours of lines—curves indicating the gradations of intensity throughout their widths and deductions as to the density with which the atoms are packed in the course of the ray of light It is stated that the weakest lines on ordinary stellar spectrograms (of intensity 1 on Rowland's scale) could be produced by 2×10^{13} atoms per square centimetre, which is a millionth of the number in a cubic centimetre of air, further, that the whole amount of gas in the sun's atmosphere, if condensed to the density of our air, would form a layer between 10 centimetres and 1 metre in thickness

Research Items

Lovelock Cave.—In 1911, during mining operations for bat guano, numerous ancient Indian objects were discovered in the Lovelock Cave in the Humboldt Valley of West Central Nevada. Further excavations were carried out under more favourable conditions in 1924 by Mr. M. R. Harrington and Mr. Loud, which are now described in a fully illustrated monograph issued as No. 1 of Vol. 25 of the *University of California Publications in American Archæology and Ethnology*. To the description of the recent excavations Mr. Loud adds an account of the objects obtained in 1912. Originally Lovelock Cave was a long shed-like rock shelter about 150 feet in length and 35 feet wide. Earthquakes and other natural agencies caused masses of rock to fall from the roof blocking the opening in front converting it into a cave. The local Indians, the Northern Paiute, have a legend that the inhabitants were Pit River Indians whom they drove out. The cave had undoubtedly been used as a dwelling place, and not solely as a cemetery and place of ceremonial deposit, as has been suggested. The earliest horizon of occupation belongs to the Basket Makers of possibly three to four thousand years ago, with possibly sixty burials in the cave, and as the cave refuse lies directly on the lacustrine deposits it begins possibly within a hundred years of the subsidence of Lake Lahontan. The deposits of human origin show no bones of the sabre tooth tigers, horses, or camels found in the lake shore gravels. The culture of the earliest occupation resembles, but is poorer than, that of the Basket Makers, nor was there any knowledge of agriculture. It resembles the hypothetical 'basic culture' of the south-west. After a deposit of five feet, a foreign influence creeps in, forming a transition period, and finally, as it grows stronger, the bow and arrow appear. Then begins a 'Later Period,' possibly about A.D. 1000, containing many articles which have their counterpart among the modern Paiute. The cave dwellers would thus appear the cultural, if possibly not the linguistic, kinsfolk of the Northern Paiute.

The Australian Aboriginal Brain.—Prof. Woollard (*Jour. Anat.* vol. 63, pt. 2, pp. 207-223) gives an account of four brains of aboriginal Australians. He finds that the aboriginal Australian brain is a small brain, extremely dolichocephalic, in which the insula tends to be exposed and the primitive features in the organisation of the striate area to be retained. His observations offer no ground for supposing that the aboriginal brain discloses any peculiar simian features or that it resembles microcephalic brains of European origin, or that it retains any special features of the fœtal human brain. He finds that the variations in the indices of the aboriginal brain present no peculiar features, and the differences between it and the European brain are adequately accounted for by the extreme dolichocephaly. The proportion of grey to white matter in the hemispheres is the same as in the European brain, and there are no significant differences between the right and left hemispheres. The total weight of the brain and the weights of the hemispheres are smaller than in the European brain.

Nervous Symptoms and Vocational Selection.—In the *Revue de la Science du Travail* (Tome I., No. 1), Dr. Toulouse directs the attention of students of vocational selection to the problem of the nervous person in the industrial world. He maintains that slight nervous troubles are infinitely more common than any one is aware of, and that their action on the output of the worker is disastrous. He contrasts the limited and ascertainable effect on output of an organic disease, with the irregular and incalculable effect of nervous symptoms. There is here no question of the intelligence, which might be of the highest order, but of an emotional or temperamental instability, over which the person has little control, leading to erratic work curves and long sickness absenteeism. He pleads for a greater recognition of this factor by those doing mental testing and for a periodic examination of employés during their industrial career. The nervous condition which in the typist may involve an unusual number of errors may in a signalman lead to a disaster. It is probable that behind an accident is an emotional instability and not a defective sense organ or intellectual weakness. A similar conclusion was reached by the Industrial Fatigue Research Board after an investigation of telegraphist's cramp: it was shown that those who suffered from that disorder, which essentially involved even in the earlier stages a diminished output, were of the temperament popularly called 'nervous'.

Sea Trout in Scottish Waters.—In his paper "Sea trout of the River Ailort and Loch Eilt, Part 2, 1920 and 1925-27. With an Appendix on Ailort Salmon" (Fishery Board for Scotland. Salmon Fisheries, 1928, No. 9), Mr. G. Herbert Nall continues his work based on scale reading, the first part of which was published in 1926. The present part embodies the results obtained by analysing both the old and the new material, a résumé being made of the whole. The sea trout of this district, like most of those of the west coast rivers, have a more uniform type of life than those of the east coast rivers, the chief features in the river Ailort being the big runs, beginning as early as March and mainly composed of fish which have spawned in the previous winter, and the high average size of the fish, a few of which attain a great weight. The size is mainly due to good feeding and favourable conditions both for the parr and the sea fish, giving rise to a vigorous stock. The Ailort fish survive to a greater age and weigh more than do those of the east coast rivers, and maturity is reached rather later. Early spawners seldom survive the tenth year from hatching, whilst amongst those which spawned later in life some exceed fourteen years, and the percentage of survivors rises with the increase in the number of sea years before maturity is attained. Spawning retards growth, but to a less degree than in the salmon. Salmon smolts usually migrate after two years of river life, those of the sea trout after three years. Salmon smolts at migration are about two inches shorter than those of the salmon trout of the same age. During this river life the salmon parr grow more slowly than those of the sea trout, but after migration the growth rate of the salmon is by far the larger. It has often been suggested that some of these large Ailort sea trout are hybrids between salmon and sea trout, but although experiment has proved that salmon eggs can be fertilised by sea trout milt and vice versa, the author is of the opinion that there is no indication of hybridisation between salmon and sea trout, nor are there two or more distinct races of the latter in the Ailort.

Parasites and Predators in Biological Control of Insect Pests.—In the *Bulletin of Entomological Research*, vol. 19, March 1929, Dr. W. R. Thompson discusses this important subject. As he points out, both predaceous and parasitic insects practically always kill their hosts. The question of their relative

value as controlling factors is, however, somewhat obscure That insect predators are numerous and beneficial is generally acknowledged, but that they are as valuable in these respects as parasites is not by any means universally believed This subject is ably discussed by Dr Thompson, who advances theoretical conclusions, partly based upon calculations of the length of time necessary for the annihilation of a given host population by given populations of gregarious parasites, solitary parasites, and predators His theoretical conclusions indicate that the value of predators has been underestimated by practical entomologists, and they are supported by the history of the practical application of biological control As examples, he quotes the efficiency of such predators as Coccinellidæ in controlling certain scale insects and mealy bugs the utilisation of the carabid beetle *Calosoma* in controlling the gipsy moth in New England and the extraordinarily valuable results attained by the introduction of the capsid, *Cyrtorhinus mundulus*, in controlling the sugar cane leafhopper in the Hawaiian Islands He concludes that predators are worthy of more careful attention than has so far been accorded them, but that the relative values of parasites versus predators in any given case can only be decided by critical investigation in the field

PRE CAMBRIAN LIFE —Some months ago it was announced in the daily Press that a pre Cambrian fauna had been discovered in South Australia Some details of this have now been given by Sir T W Edgeworth David in "Notes on newly discovered fossils in the Adelaide Series (Lipalian ?), South Australia" (*Trans Roy Soc S Australia*, 52, pp 191 209, pls xiii xviii, 1928) He considers that he has found the remains of Algæ, polychætous annelids, brachiopods, and eurypterids in the Adelaide Series at horizons ranging from 2000 to 12,000 feet below the oldest rocks in which undoubted Lower Cambrian fossils have been traced The age may be (1) basal Lower Cambrian *or* (2) Lipalian, that is, belonging to the time represented in North America by the unconformity between the Keeweenawan and the base of the Cambrian, *or* (3) Proterozoic (Algonkian) Without seeing the specimens on which Sir Edgeworth David's views are based, it is almost impossible to express an opinion as to their nature The figures which he gives are not convincing If he has really found eurypterids in beds of pre Cambrian age, it is difficult to account for the fact that scarcely any undoubted representatives of that group of arthropods have been discovered in the Cambrian

TROPICAL AGRICULTURE —The Imperial College of Tropical Agriculture, Trinidad, has issued its report for 1927–1928 together with the prospectus for 1929–1930 Developments have been made in all directions, and further extensions are hoped for in the near future An estate is specially needed for research, principally into biological problems, as the existing grounds are required for the instruction and training of students The power station is now in use and the new building for low temperature research and cold storage is completed, although the interior fittings of the latter are not yet finished The construction of a new chemical block is proceeding, and alterations and additions have been made in the sugar factory In research work good progress has been made With regard to bananas, the main objects are to secure good marketable varieties immune from Panama disease (a problem which necessitates a study from both the pathological and physiological point of view), and further to investigate the ripening process in order that the fruit may be successfully marketed overseas The new cold storage chamber will prove of special benefit in these problems Soil research with reference to the sugar cane crop has been successfully carried out The lime content of the soil, and particularly the proportion of adsorbed calcium ions, has been shown to be correlated with the resistance of the plant to froghopper blight A practical outcome of this work is that the College is now able to advise growers as to the amount and kind of lime to apply to their fields and the methods of application to employ On the other hand, insecticide work has also proved successful, and the froghopper pest can now be kept under control if the proper executive arrangements are made at the right time, the cane growers acting collectively The main objects of research in the coming year are problems dealing with tropical fruits such as bananas and citrus, biological investigations of cacao, and genetical and fertiliser trials with sugar cane

ISO ELECTRIC POINT OF CELLS AND TISSUES —In a recent number of *Biological Reviews* (4, p 1) H Pfeiffer has contributed a comprehensive review of the now voluminous literature bearing on this subject, in which he points out that the original conceptions of the iso electric point (IEP) are tending to develop both in physical chemistry and in biology Cells and tissues of plants, and perhaps of animals, show many analogies with ampholytes, probably owing to the presence of these substances at the cell surfaces and at the internal boundaries of the protoplasm From the observed effects, attempts have been made to determine the IEP in the case of a given tissue, and also to explain the regulatory effects of the cells upon external solutions Pfeiffer points out that most biological work has been concerned not with the *true* IEP, which is given by the stationary phase in electro cataphoresis, but with the *apparent* IEP (as found, for example, from minima of swelling, viscosity, and osmotic pressure), which depends primarily on the reaction at which there is a maximum of neutral molecules The apparent IEP determined in this way may be displaced owing to salt formation, and this is particularly likely to happen in the case of protoplasmic ampholytes Further, the presence of two or more ampholytes in protoplasm does not, on present conceptions, necessarily lead to the establishment of a collective IEP as it may tend to do *in vitro* There may, in cases known, be signs of a number of apparent iso electric points The relation of the apparent IEP to growth and physiological functions of the organism is discussed, and the author emphasises the view that further work is required on the effect of these phenomena on ion movement and the electro histological behaviour of protoplasm, and on the mechanism of such functions as protoplasmic streaming

CYCLONES AT MAURITIUS —Mr R A Watson, Director of the Royal Alfred Observatory, Mauritius, is to be congratulated for producing "The Cyclone Season 1927–8 at Mauritius," which is to be the first of an annual series of publications summarising the information collected at that Observatory about the cyclones occurring in the neighbourhood during each cyclone season The cyclone season in Mauritius extends normally from November to May, the one under discussion was one of the stormiest on record, and was remarkable also for the fact that the tracks were farther west than usual, to which peculiarity the absence of gales at Mauritius itself is to be referred The weather reports from neighbouring islands were supplemented by information supplied by ships calling at the island In two instances enough observations were available to allow of the construction of diagrammatic systems of wind arrows in which the wind represented is the wind relative to the moving centre, the isobars being shown in the usual way It is interesting to

find some evidence of a discontinuity of wind along the actual track in front of the centre and not as was found by Cline in the case of West Indian hurricanes (NATURE Dec 24 1927 p 909) between the winds of the two quadrants on one side of the track Allowing for the reversal of the circulation as between storms of the northern and southern hemispheres the analogue for Mauriti is of the right rear and right front quadrants between which the discontinuity was found by Cline would be the left rear and left front quadrants These diagrams are of interest also in that they show some flattening of the isobars in a direction parallel with that of the track and constitute additional evidence of a lack of that symmetry of wind circulation usually attributed to the tropical cyclone in meteorological text books

THE AURORA —The investigation of conditions in the upper air which has been made by E O Hulburt and H B Maris in connexion with their theory of the aurora and of magnetic storms (*Physical Review* vol 33 pp 412 431 see also NATURE Nov 24 1928 p 807) is remarkable for the importance which is attached to the influence of the ultra violet radiation from the sun The wave lengths which are absorbed at heights above about 450 kilometres are supposed to produce indirectly by processes of excitation and ionisation a kind of spray of highly rarefied matter which extends outwards for upwards of forty thousand kilometres Collisions are very infrequent at the low pressures involved and the molecules can describe practically free orbits in the earth s gravitational field If one is ionised by further absorption of ultra violet light both the liberated electron and the residual positive ion will return to the lower air in helical paths the axes of which are determined by the earth s magnetic lines The aurora is associated with the downward currents and its distribution over the surface of the earth can be predicted immediately from the magnetic field of the latter This theory which has been developed on quantitative lines seems to account adequately for the main phenomena both of auroræ and of the complicated changes which occur in the magnetic elements during a magnetic storm and the greatest difficulty in its further development is likely to arise from incomplete knowledge of the precise nature of the atomic processes of excitation and ionisation The authors mention incidentally that good direct short wave communication was maintained between the U S Naval Research Laboratory at Washington and the Byrd Antarctic expedition

EFFECT OF HEAT ON THE SENSITIVITY OF PHOTOGRAPHIC PLATES —The results of an investigation of the effect of heat on the sensitivity of photographic plates are described in two papers by O Masaki in the *Memoirs of the College of Science Kyoto* Series A vol 12 No 1 It was found that the sensitivity of panchromatic and other slow emulsion plates increased with rise of temperature the sensitisation being greatest towards the red part of the spectrum In the case of high speed plates rise of temperature produced a decrease in sensitivity especially in the violet region For all kinds of plates heating increased the contrast and in panchromatic and orthochromatic plates this change was particularly marked for rays of long wave lengths The sensitising action of heat was retained for some hours after the temperature had been reduced to normal and was much greater than that produced by mere drying of the plates An expression giving the relation between the density of the developed image and temperature was obtained and holds from 10° C to 80° C

FLAME AND SPARK SPECTRA FROM SALT SOLUTIONS —In the *Chemiker Zeitung* of Mar 16 Dr W Hirschel describes some quantitative results which he has obtained with the apparatus first described by him in 1916 in which minute amounts of salt solutions are pulverised by means of a spark before being introduced into the Bunsen flame The resulting flame can be maintained for an hour with the consumption of only a few milligrams of salt and the flame is so intense that its spectrum can easily be photographed The apparatus has hitherto been used for the visual examination of spark spectra but it has now been found possible to photograph the latter This has necessitated the use of much stronger sparks than were possible in the original apparatus A device for cooling the anode with cold water has been introduced and instead of a large induction coil and battery of cells a simple Wehnelt Simon Caldwell interrupter is used with an alternating current at 115 220 volts and a small coil

ATOMIC WEIGHT OF COPPER —A communication by T W Richards and A W Phillips in the February number of the *Journal of the American Chemical Society* describes experiments on the atomic weight of copper from different sources No difference was found in the atomic weights of specimens of copper from mines in the Lake Superior region and from Chile The ratio of the atomic weights of copper and silver was found by analysis of pure cupric chloride On the basis of Ag = 107 880 the atomic weight of copper was found to be 63 557 Copper is known to have at least two isotopes and its atomic weight was in need of confirmation The Lake Superior material was not later than Cambrian that from Chile was from lodes intrusive in Jurassic strata

SIZE LIMITS OF TURBO GENERATORS —During the last few years there has been a remarkable increase in the size of the turbo generators used in electric power stations The size of the machines which run at 25 revolutions per second is now only limited by the transport facilities available to their destination The desirable size of the machines which run at the standard speed of 50 revolutions per second is about 60 000 kilovolt amperes at the present time but in a few years machines of double this capacity will probably be running The uncertain factors are the strength of the forgings forming the rotating part and whether the journals for such heavy machines would be safe The centrifugal forces and the consequent enormous stresses in the rotating parts at these high speeds make it necessary to use only forgings of the greatest mechanical strength In a paper read by J A Kuyser to the Institution of Electrical Engineers on Mar 21 it was stated that a steel containing about 2 per cent nickel with a very small percentage of chromium when properly annealed has the necessary tensile strength On the Continent the alloy used for high speed machines has a much larger percentage of nickel and chromium and is hardened in oil However experiments carried out by Metropolitan Vickers led to the conclusion that the oil hardening of this steel produces a high radial stress which when the machine is running is added to the centrifugal stress A significant fact is that on the Continent during the last three years there have been four explosions with several fatalities of high speed machinery made of this steel It was stated that several of the older types of machines are operating with parts of their core at 200° C These high temperatures cause relative displacements of the copper and the mica insulation, as the temperature coefficient of copper is 50 per cent greater than that of mica

Mimicry

By Dr G D HALE CARPENTER, Entebbe, Uganda

THE phenomena of mimicry, by which is meant the deceptive resemblance of one creature to another, were first made known among butterflies, and it is natural that the subject should have been further investigated in the same group of insects But it has suffered thereby, for the narrowing of the field of inquiry has resulted in attempts to account for the phenomena which do not bear criticism in the light of wider knowledge and more detailed investigations into geographical distribution

Mimetic resemblances are undoubtedly most convincingly explained as the result of the operation of natural selection upon such variations as may be produced from time to time We may in this connexion quote the words in which Darwin, writing to Asa Gray, expressed his confidence in natural selection as the motive cause of evolution "I cannot possibly believe that a false theory would explain so many classes of facts as I think it certainly does explain On these grounds I drop my anchor, and believe that the difficulties will slowly disappear "

Since H W Bates first published his memoir on mimicry in 1862 an immense number of field observations have been recorded and a large amount of work has been expended upon museum specimens, but the theory of natural selection still offers the most convincing explanation of the facts

Attempts have been made to account for mimetic resemblances by the similar results produced by climatic or other external influences upon different species in the same locality, and such an explanation is given by Prof E W MacBride in his essay on "Zoology," p 211, in the collection of papers published in 1925 by Messrs Blackie and Son under the the title of "Evolution in the Light of Modern Knowledge"

Prof MacBride observes "We have given to our readers strong reasons for disbelieving altogether in random variations, and therefore what we have to explain is why evolution has set in such a direction as to cause these insects to resemble one another Now, Eimer has shown that the changes in coloration which the mimic is supposed to have undergone, in order to increase its resemblance to the model, are of a kind which supervene independently in all families of butterflies and moths as *a reaction to climatic conditions* These changes take place in some families more quickly than in others, and what happens in real 'mimicry' is apparently that individuals which have reached a certain stage in this process are favoured by natural selection "

Mimetic resemblance is thus believed to have been caused by an inherited response to environmental influences "Just as in the formation of habit the action becomes easier with every repetition, so as the generations succeed each other the response to the same environment becomes more readily called forth" Prof MacBride alludes later to "the vast sea of facts which tell in favour of habit as being the prime cause of evolution" He acknowledges the unsatisfactory nature of this as an explanation of mimicry, how unsatisfactory it is and how completely it fails to account for recently discovered facts it is the purpose of this article to show

Let us first consider some examples from among the butterflies alone, as this explanation was founded on a study of their patterns

1 The effects of intrusion of a foreign species upon the indigenous inhabitants

(*a*) A very good example is that of the 'Monarch,' a Danaine butterfly belonging to an Asiatic group which invaded North America in comparatively recent times, and is there mimicked by an indigenous butterfly, the 'Viceroy,' closely related to our 'White Admirals' of Europe Clearly, if these resemblances are the result of local climates, the 'Monarch' ought to have mimicked the 'Viceroy'!

(*b*) Again, in the eastern Fijian islands a group of Euploeine butterflies is characterised by a dark ground colour with a feeble or obsolete white marginal pattern, while the same species are represented in the western islands of the group by forms with a strongly marked pattern Prof E B Poulton has suggested that these facts are to be explained by an earlier invasion of Fiji by the dark Euplœas and a later powerful invasion by a strongly patterned *Euplœa*, which has reached the western islands in numbers and has become the model mimicked by the older darker species

2 The phenomena of mimicry, even among butterflies, cannot be disposed of so easily as Eimer's explanation suggests, they are much too complicated The study of geographical races is all important in this connexion

(*a*) A typically aposematic or warningly coloured species of the Acræine genus *Planema* (*P epæa*) has in West Africa a black and orange male and black and white female In the Uganda race *epæa paragea*, however, the sexual dimorphism disappears and the coloration of both male and female is grey brown with a pattern of cream-colour Both these races are mimicked by the females of *Papilio cynorta*, which in West Africa resemble the black and white females of *epæa*, and in Uganda both sexes of *epæa paragea* The *Papilio* male retains the same appearance in both areas On the other hand, a Nymphaline butterfly in Uganda, *Pseudacræa eurytus*, allied to our 'White Admirals,' has developed a form *obscura* in which both sexes mimic *epæa paragea* Climate, according to Eimer's hypothesis, has caused one sex of the *Papilio* to resemble the model but both sexes of the Nymphaline This, however, is far from the end of the story *Pseudacræa eurytus* occurs all over tropical and subtropical Africa in a bewildering variety of forms, sometimes with sexes alike, as in the form *obscura*, sometimes unlike Wherever these *Pseudacræas* occur they are mimetic of the local species of *Planema*, sex resembling sex when the sexes of the model are unlike But in Uganda some of the *Planema* models, such as *epæa paragea*, have the sexes alike, while in others they are different, and the local forms of *eurytus* mimic both types Hence in the same area, and therefore subject to the same climatic influence, most surprisingly complicated and contrasted results have been developed It may be argued that equally complicated results have arisen among the models in the same area, but there is this essential difference—the Planemas are of entirely different species, whereas the mimetic forms of *eurytus* belong to a single species, so that mimics with sexes different and with sexes alike form a single interbreeding community and may appear side by side in a single family

(*b*) Equally difficult to explain by Eimer's theory are the intricate mimetic resemblances between members of the fine genus *Charaxes* Some of the larger species which act as models for the smaller are themselves mimics of other large species, and one sex of a species may be a mimic while the other is a model Yet another species (*etheocles*) has a non

mimetic male which varies little, but the females occur in strikingly different forms which mimic the males, others the females, and others again both males and females of larger species

3 Explanations of mimicry are too often based on consideration of colour and pattern alone Any naturalist familiar with mimetic resemblances in the field has found by practical experience that colour and pattern are only part of the factors which make up the deception, behaviour is of great importance Even among butterflies themselves the difference of behaviour between models and some mimics is characteristic, if the mimic belongs to a family less well protected than the model For example, the Acræine models of the genus *Planema* can often be picked from flowers by the fingers, while the mimetic forms of *Pseudacræa eurytus* are shy, and require to be approached with caution if they are to be caught If frightened they dash away, whereas the *Planema* will only flutter just out of reach and often boldly return to the same spot

Even if it be admitted that the action of climatic conditions is effective in causing different species of insects to develop the same variations in coloration, it cannot be held to explain instances of mimicry drawn from a much wider field than that from which Eimer drew his examples How could the likeness of certain spiders to ants be put down to this cause? Many instances have been recorded where the mimicry has completely deceived experienced field naturalists Climate in this case must be supposed to have altered profoundly the characteristic shape of spiders so as to produce the 'waisted' effect of an ant, to have altered gait in such a way that one pair of legs is not used for progression but is held up in the air and waved about to resemble the sensitive antennæ of an ant, and even, in certain spiders, to have suppressed, except in very special circumstances, the habit of jumping that is characteristic of the family to which most ant like spiders belong

Spiders, having no metamorphosis, are generally exposed to similar conditions at all stages of their existence Insects which undergo complete metamorphosis are exposed to conditions during their immature stages which often differ as completely as possible from those to which the adult stages are exposed The close resemblances often found between adult insects cannot possibly be explained as due to the action of absolutely dissimilar conditions upon their respective larvæ For example, the mimetic resemblance of the common drone fly to the hive bee deceives even a monkey, as I have found by experiment in Africa The larva of the fly lives in mud and foul fluids among which it feeds in the open, freely exposed to changes of light, temperature, and oxygenation The bee's grub is enclosed in a small cell in the hive, among surroundings as uniform as the bees can make them, feeding on food supremely different from that of the fly's larva Malacoderm beetles of the family *Lycidæ* all over the tropics are mimicked extensively by insects of such diverse habits, and feeding in such different ways as larvæ and adults, that no explanation based on the influence of external circumstances can account for the well known mimicry of these conspicuous beetles, which have been abundantly proved to be distasteful to birds and other animals

4 Mimics differ from their models not only in behaviour but also in other respects A typically aposematic insect such as an Acræine or Danaine butterfly, or a Lycid beetle, is of an extremely tough physique It will be uninjured by treatment which would break the wings of another butterfly such as the Nymphaline or Papilionine mimic, and it will also resist the poisonous fumes of a cyanide bottle to a surprising extent This resistance to injury is part and parcel of the process whereby an aposematic insect teaches an enemy that it is harmful or unpalatable It almost invites attack, and if it is seized and handled, suffers little injury, and when released after a pinch or a lick is often undamaged This difference in physique and temperament, coupled with similarity of superficial appearance, is difficult to explain by climatic action

5 Another class of facts telling against the argument now discussed is the production of the same effect in a variety of ways The thin 'waists' of Hymenopterous insects are frequently mimicked in stout bodied insects of other orders by either white colour or dense white pubescence which at a little distance effectively 'paints out' part of the body, leaving only a thin waist visible

6 It is usually found that mimetic resemblance only goes so far as is necessary to produce a *superficial* deceitful appearance, often the characteristic appearance of the group to which the mimic belongs may be found in or on parts which do not interfere with the mimetic resemblance

The antennæ of beetles which mimic other beetles might often be a hindrance, for whereas in the mimic the characteristic antennæ of its family may be long and thin, the antennæ of the distasteful model may be short and stout This difficulty is surmounted in the mimic by a thickening of the antennæ for a distance approximately equal to that of the thick antennæ of the model, the remaining segments of the long antennæ being thin and relatively inconspicuous The influence of external circumstances must here be very patchy!

7 Such examples of mimicry as the resemblance of large Sphingid caterpillars to some terrifying reptile with large eyes can scarcely be explained by the influence of climate

8 It is somewhat difficult to understand why the explanation of mimicry by the action of natural selection has been a stumbling block to many The fact that many insects escape their enemies by minutely resembling objects that are of no interest to them, such as a bird dropping, is usually accepted as an example of the working of natural selection Yet when the object that is of no or relatively little interest to the insectivorous creature is another insect, it has been claimed by some writers that natural selection cannot be the agent which has effected the resemblance Mimetic resemblances, as was long ago shown by Prof Poulton, are only one example of various types of deceitful resemblance Natural selection will account for them all as well as for the examples of conspicuous 'warning' colours Why, then, should it be thought necessary to invoke an explanation for one set of resemblances which is supposed to be powerless to account for others?

9 Prof MacBride, in the article alluded to earlier, remarks that "it is assumed, often on very insufficient evidence, that the one of the two animals which is the commoner (*i e* the model) has some peculiar feature which makes it dangerous to the animals which would attack it, and that these learn to recognise it and avoid it"

It is true that when the theory of mimicry was first propounded there *was* very little direct evidence, but critics of the theory often seem to be unaware of the body of experimental and observational evidence that has been accumulated during recent years in the publications of the Entomological Society and others

It is sometimes a stumbling block to critics that insects which are supposed to act as models have been seen to be devoured freely by certain enemies For

example, I have myself obtained evidence that ants are a very important element in the food of Agamid lizards, and Danaine butterflies have been seen to be devoured by certain birds In this connexion the old adage should be remembered, "One man's meat is another man's poison" It is important also to remember that not even the most enthusiastic supporter of mimicry claims that models are at all times and in all circumstances exempt from being devoured I have seen the foul smelling and evil looking black 'Devil's coach horse' beetle pulled out from among dead leaves by a wren in a wood and devoured in mid winter Edibility is entirely a question of the relative abundance of food it is not without significance that mimetic resemblances reach their highest development in those parts of the world where insect life is most abundant

10 Another stumbling block may be given in Prof MacBride's words "It is held that the predatory animals mistake the defenceless species for the dangerous one, and that so the defenceless one escapes"

I do not think it is necessary to suppose this all that is required for the protection of *B* is that it should sufficiently resemble *A* to remind the enemy of an unpleasant experience connected with an attempt to eat *A* When food is abundant a very slight degree of resemblance to a creature known by previous experience to be unpleasant may save the life of another This is within the bounds of human experience Many people intensely dislike worms "because they wriggle so" Why should a wriggling movement be more unpleasant than, for example, the sudden leaping of a frog? Surely, because of man's origin, in countries where an instinctive dread of a snake was a criterion of life and death It is not that we think worms *are* snakes, but they remind us of them This point of view makes it much easier to understand cases where a mimic is much larger or smaller than its model, or where the resemblance is very elementary, or even depends but little upon colour but rather upon some trick of movement or posture

In all such cases there is nothing in the theory of mimicry produced by selection of variations to prevent further improvement of the resemblances, nor on the other hand, is there any reason why a slight degree of resemblance *must* be perfected, all that is necessary is that the resemblance should remind an enemy of some previous unfortunate or unpleasing experience Thus perfect and imperfect mimetic resemblances may exist together

11 Finally, I would allude to the wonderful deceptive resemblances of the eggs of cuckoos to those of the nest in which they are placed [1] In this case the enemy is the parent of the eggs resembled, which are the models The phenomena are analogous to mimicry, there is a resemblance to something which the enemy will not attack, one theory will explain the evolution of both these classes of deceptive likeness Can it possibly be claimed that these minutely detailed resemblances between eggs of birds are of a kind which supervene independently in the eggs of cuckoos and host birds as a reaction to climatic conditions? The answer is surely, 'No' and the same answer may be given to the claim that "What happens in real 'mimicry' is apparently that individuals which have reached a certain stage in a reaction to climatic conditions are favoured by natural selection"

[1] See the papers by E C Stuart Baker *Proc Zool Soc*, 1923 p 277 and F C R Jourdain *ibid* 1925 p 639 See also presidential address to Ent Soc Lond, Jan 20 1926 by Prof E B Poulton

Diamond Jubilee of the Iron and Steel Institute

THE May meeting of the Iron and Steel Institute to be held this year on May 2 and 3 is of special significance inasmuch as the Institute is celebrating its diamond jubilee The proposal for the formation of the Institute originated at a meeting of the Northern Iron Trade, held at Newcastle on Tyne on Sept 29, 1868, and a committee was appointed with the object of giving effect to this suggestion Mr Isaac Lowthian Bell (as he then was) took a prominent part in the proceedings from the very beginning, and it was largely through his influence and efforts that the Institute took shape

A provisional meeting was held in London in February 1869, at which the Institute was formally constituted, the Duke of Devonshire consenting to accept the position of president for the first two years The inaugural meeting was held on June 23, 1869, in the Hall of the Society of Arts, when the noble president delivered a most interesting inaugural address, in which he traced the development of iron and steel manufacture The next meeting of the Institute was held at Middlesbrough on Sept 22 and 23 of that year, the first paper, appropriately enough, being by Mr Isaac Lowthian Bell

The Institute was by this time fairly formed, the first secretary being Mr J Jones and the first treasurer Mr (afterwards Sir) David Dale At the end of that year the Institute numbered 292 members, to day the membership is just over 2700, and this numerical increase is good evidence that the work of the Institute has met a real need in the iron and steel industry The object of this, as indeed of all similar technical societies, could scarcely be better stated than it was by the president in his inaugural address, when he declared the object of the Institute to be "the promotion of science in its practical applications rather than in its purely intellectual aspects," and it may fairly be said that this principle has been the dominating principle of the Institute

The jubilee of the foundation of the Institute was celebrated by a banquet in the Guildhall on the evening of May 8 1919, at which the then president of the Institute Mr Eugene Schneider, of the famous Creusot Works, presided supported by a very distinguished company As was not unnatural in the spring of 1919, the conclusion of the War was the thought uppermost in men's minds and this fact so overshadowed the fact that this was the jubilee meeting of the Iron and Steel Institute that relatively little attention was paid to the fact that the Institute had then attained its half centenary of existence On this account the celebration of the diamond jubilee this year is likely to assume an even greater importance than it otherwise would

It is interesting to note that there are still three members whose membership dates from the inaugural meeting of the Institute in London, namely, Sir Hugh Bell, Bart, himself a past president and a Bessemer medallist, who joined the Institute at the same time as his father the late Sir Isaac Lowthian Bell, Bart, who, as already pointed out took a prominent part in the formation of the Institute, Mr J J Bleckly, of the Pearson and Knowles Coal and Iron Co, Ltd, and Mr John Neilson, a nephew of the late James Beaumont Neilson, the inventor of the hot blast, which practically revolutionised the blast furnace practice of the world The Institute can fairly claim to have counted among its list of members every one of the men who have been distinguished in the iron and steel industry for the last sixty years, and

the history of that industry and of its wonderful development is to be found in the *Journal* of the Iron and Steel Institute

No one can doubt that the Institute will continue to go forward and prosper along the same lines traced out for it by its founders, which it has so consistently followed throughout the whole sixty years of its existence, and it seems almost superfluous to wish for a continuance of its prosperity for many years to come This wish will indeed be fervently re echoed by everyone in Great Britain, seeing that the prosperity of the Iron and Steel Institute is bound up with the prosperity of the iron and steel industry, which in its turn is the foundation of the prosperity of the nation

The Stone Age in South-Eastern Asia

RECENT research appears to point to more or less uniformity in the characteristics of the stone age cultures of south-eastern Asia Investigations in French Indo China by MM Mansuy and Patte and Mlle Colani in the caves near the Bac Son massif (Tonkin) yielded a large number of implements which these investigators regarded as relics of the oldest known stone age of Indo China, classifying them as lower neolithic Cord marked pottery was also found, but regarded as belonging to a later phase of the neolithic Evidence of similar stone age industries has been found in kitchen middens about twenty kilometres from Medan in the east coast province of Sumatra, and on the plains and lower hills of this province at sites always on the banks of rivers

In the *Journal of the Federated Malay States Museums*, vol 12, Part 6, Mr I H N Evans reviews this material critically in relation to the results of recent excavations in caves in Perak The hypothesis of the French archæologists is that an early neolithic people, using roughly chipped implements only, came into contact with a people using polished implements, and from them adopted the practice of polishing the edges of their implements Mr Evans, however, regards the chipped implements as a truly older palæolithic culture, surviving in association with the forms with polished edges which are proto neoliths, the latter developing more and more to become a high neolithic culture In Sumatra, iron weapons of a type still in use in north Sumatra in a layer immediately above that containing bouchers, with no sign of transition, pointed to a very late survival of a palæo lithic culture

In Perak, Mr Evans, excavating with Dr P U Van Stein Callenfels, of the Archæological Service of the Netherlands Indies, who carried out the investigations in Sumatra, found similar stone age cultures in caves near Lenggong (Upper Perak) and Padang Rengas (Kuala Kangsar) In the latter area the rock shelter, Gua Kĕrbau, contained human remains at a depth of 3 18 metres and below Shellfish formed a large part of the diet of the inhabitants throughout the occupa tion Flakes and chips occurred throughout, but the first palæolith was found in deposit *B*, the most common type being the *coup de poing* of almond shape The first fragment of a proto neolith occurred in layer *D* at a depth of 2 40 metres The lowest was found at 5 74 metres The proto neoliths showed different stages of development One might be classified as a middle neolith Grinding stones, grinding slabs, shells, some clearly, others probably, for use as amulets, and pottery in the upper layer were found

Certain conclusions are offered tentatively Palæo liths, so called Sumatra types, and proto neoliths, are associated throughout, cord marked pottery belongs to the later stages of palæo proto neolithic culture, the makers of proto neoliths had older types of the neolithic culture as examples, and a palæolithic civilisation making use of 'Sumatra type' implements spread at a certain period over south-east Asia, reach ing even Sumatra, while the palæo proto neolithic stage also spread over the same area but did not reach Sumatra

University and Educational Intelligence.

LEEDS —The site is now being cleared for the new block for the Physics Department The accommoda tion will include two large laboratories, each about 5000 square feet in area, and a smaller laboratory for honours students, three lecture theatres for 250, 150, and 80 students respectively, and about thirty other rooms, the whole occupying a block about 100 feet square and comprising a basement and three floors over The building is estimated to cost about £47,400

LONDON —Notice is given that applications for grants from the Thomas Smythe Hughes Fund for assisting medical research must reach the Academic Registrar, South Kensington, S W 7, by, at latest, June 15

ST ANDREWS —At a meeting of the University Court on April 19, it was intimated that Provost W Norman Boase, St Andrews, had gifted to the United College the endowment fund for the institution of a residential entrance scholarship of £100 a year, tenable for three or four years by an entrant student resident in one of the residential halls of the United College, on conditions similar to those prescribed in the case of the Harkness, Russell, and Patrick Hamilton Entrance Scholarships As the Patrick Hamilton Scholarship was instituted in commemora tion of the quater centenary of Patrick Hamilton, the Martyr, a former student of the University, so the new scholarship is to be named the Montrose Scholarship in commemoration of the tercentenary of the studentship at St Salvator's College of the great Marquis of Montrose

APPLICATIONS for grants from the Dixon Fund of the University of London, for assistance in scientific investigations, must reach the Academic Registrar of the University, South Kensington, S W 7, before May 15

A BUSK Studentship in aeronautics, of the value of about £150 and tenable for one year from Oct 1 next for research in aeronautics and specially in stability problems, is being offered Forms of application, returnable not later than May 12, can be obtained from Prof B Melvill Jones, Engineering Laboratory, Cambridge

A FELLOWSHIP of the value of £300 per annum for research on petroleum problems is being offered by the Institution of Petroleum Technologists The fellow ship will be tenable for one year, with a possible re newal for a further year Forms of application (returnable by June 1 at latest) are obtainable from the Secretary of the Institution, Aldine House, Bedford Street, W C 2

APPLICATIONS are invited by the trustees of the Dickinson scholarships in connexion with the Man chester Royal Infirmary and the University of Manchester for the following A research travelling scholarship in medicine value £300, and a pathology scholarship value £75 Particulars may be had from the Secretary to the trustees, Royal Infirmary, Manchester The completed forms must be returned by May 2

Calendar of Patent Records.

April 27, 1844.—The aneroid barometer was the invention of a Frenchman, Lucien Vidie, and was patented in England in the name of De Fontaine moreau, merchant, of London, on April 27, 1844. The advantages that it possessed over the mercury instrument, especially as regards portability, were apparent directly its accuracy for general purposes had been tested, and it was soon extensively adopted, especially in Great Britain.

April 27, 1909.—The modern metal spraying process for coating iron and steel is largely due to the Swiss chemical engineer, Dr. M. U. Schoop, whose first patent was applied for in Germany on April 27, 1909. The English patent was granted the following year.

April 28, 1784.—Stereotype printing was first introduced about 1726 by William Ged, but the earliest patent for the process was that granted to Alexander Tilloch and Andrew Foulis, printer to the University of Glasgow, on April 28, 1784. These and others of the early processes, though actually used for printing books, were only practised by the inventors themselves, and it was due to Lord Stanhope, who had been taught the art by Foulis, that the possibilities of the new method were generally realised. It was not, however, until the use of papier mâché for the matrix, in place of the plaster of paris formerly employed, was invented in France about 1828, that stereotyping was extensively adopted.

April 29, 1790.—On April 29, 1790, William Nicholson was granted a patent for the first rotary printing machine. Though the invention was not put into practice, it embodied suggestions which were successfully introduced by Koenig in his flat bed cylinder machine of 1811, and by Applegarth in his rotary press some years later.

April 30, 1844.—The 'Lancashire' steam boiler was the invention of Sir William Fairbairn and was patented by Fairbairn and John Hetherington on April 30, 1844. The boiler, which differs from its predecessor, the 'Cornish,' by having two tubular flues instead of one and by being internally fired, was the most economical one of its time, and by reason of its simplicity and its capacity of withstanding rough treatment, is still frequently preferred to other types for certain purposes.

May 1, 1704.—The use of jewelled pivot holes in watches was the invention of Nicholas Facio de Duillier, a Swiss resident in London, and a fellow of the Royal Society, and a patent for it was granted to him in conjunction with two London watchmakers, Peter and Jacob Debaufre, on May 1, 1704. A petition presented to the House of Commons for the prolongation of the patent was successfully opposed by the Clockmakers' Company, but it has since been discovered that the evidence which was the principal factor in securing the rejection of the petition was not genuine, and was probably 'faked' for the occasion.

May 2, 1782.—Among the claimants for the new prizes offered by the Board of Longitude for improvements in the marine chronometer after the award of the original £20,000 to John Harrison in 1764, were the rival London watchmakers, John Arnold and Thomas Earnshaw, who share the right to be called the inventor of the modern chronometer escapement, though the exact share of each in the invention has not been satisfactorily determined. It is precisely Earnshaw's escapement that is now in universal use, but Arnold's construction is very similar, gives few points to the other, and was the first, by a year, to be patented, the date of the grant being May 2, 1782. Arnold was the first to manufacture chronometers on a commercial scale.

Societies and Academies.

London

Physical Society, Mar. 8.—**Ezer Griffiths** and **J. H. Awbery**: The dependence of the mobility of ions in air on the relative humidity. The apparatus employed was a modification of Zeleny's original method, the end of a wind channel being closed by a disc of gauze fitted with a guard ring through which a steady stream of air of definite humidity was pumped. The motion of the negative ions due to the action of the air stream was balanced by a counter potential gradient, and the mobility deduced from the critical potential required to produce a balance. The rate of air flow was measured by means of an Ewing ball and tube flowmeter, using a hollow glass sphere to make it suitable for low air rates. Efforts were made to construct a direct indicating instrument.—**A. M. Tyndall**, with a note by **C. F. Powell**: Some unsolved problems relating to the mobilities of gaseous ions. The address dealt with: (1) Established results and proposed theories; (2) the difference between positive and negative mobilities; (3) the effect of vapours; (4) mobility in pure gases; (5) positive ions of short age; (6) suggestions as to future progress. Note by Mr. C. F. Powell: An apparatus of the 'four gauze' type has been designed for experiments with highly purified gases.

Linnean Society, April 4.—**G. M. Graham**: The natural history of the Victoria Nyanza. The Fishing Survey of Lake Victoria, 1927–1928, was carried out, by the author and Mr. E. B. Worthington, to solve a problem in economic fisheries. This involved a study of the general ecology of the lake. The cichlid fish, *Tilapia esculenta*, is the most important food species, and next in importance is *T. variabilis*. Excluding the shore, the lake may be divided into certain ecological zones—(1) the surface waters; (2) the deep mud region (190–230 feet); (3) the intermediate zone (50–150 feet); (4*a*) shallow water (less than 50 feet) where the ground is exposed; (4*b*) shallow water where there is shelter. These zones are distinguished by their fauna. The tropical situation of the lake results in (1) a constant plankton population; (2) rapid growth and decay, with perhaps more virulent parasitism; (3) more or less continuous reproductive activity.—**G. P. Bidder**: On the classification of sponges. In 1927 reasons were shown for regarding Hexactinellida, on account of their naked cells, as forming a phylum separate from the horny, calcareous, and four-ray sponges, with no common ancestors below Choanoflagellata. The needle sponges are now put in the latter phylum, and a complete classification is given.

Paris

Academy of Sciences, Mar. 18.—**P. Séjourné**: The line from Nice to Coni. Details of the construction of a new Alpine line, 63 kilometres long, more than one third of which is tunnel.—**Henri Villat**: A fundamental problem of the theory of vortices.—**Charles Achard** was elected a member of the Section of Medicine and Surgery in the place of the late Fernand Widal.—**Paul Pelseneer**: Academic biostatistics. A comparison of the age at election, average years membership, and age at death of members of learned societies at Paris, Brussels, London, and Washington.—**Dubourdieu**: The topological invariants of networks of curves and surfaces.—**Etienne Halphen**: A theorem on quadrics analogous with that of Chasles on conics.—**Hadamard**: Observation on the preceding note.—**Paul Mentré**: The principal surfaces of complexes of right lines.—**J. A. Lappo-Danilevski**: The

singularities of integrals of systems of linear differential equations with arbitrary rational coefficients —Radu Badescu Abel's integral equation generalised —R Gosse The determination of the equations $s = p\omega(x, y, z, q) + \theta(x, y, z, q)$, which admit an involution of order 2 and a second involution of higher order —Léon Pomey The integration of differential equations with general initial conditions (real variables) —Ernest Esclangon The apparent displacements of the pole star The Observatory of Strasbourg possesses a long series of observations of the pole star. An analysis of these data shows that the position of this star is not known with the precision desirable The possible causes of this systematic error are considered —Albert Arnulf, A C S Van Heel and Emile Perrin An optical method for the localisation of polished surfaces —Charles Guilbert A method of measuring very small electric currents, called tachymetric electrometry — R de Mallemann Magnetic rotatory power in an anisotropic medium — Decombe Pulsating electrified spherical pellicles, the principle of areas, and the Zeeman phenomenon —A Segay The inflammation of fire damp by explosives Discussion of the effect of adding common salt to the explosive and of placing a small cartridge containing liquid carbon dioxide alongside the explosive —H Caron and L Vanbockstael A new isomorphous series of fluorine compounds Mixtures of hydrofluosilicic acid, calcium chloride, and aluminium sulphate give octahedral crystals, the composition of which was found to be $4CaSiF_6$, $8CaF_2$, $Al_2(SO_4)_3$, $45H_2O$ These are very slightly soluble in water and may be utilised in microchemical analysis as a test for calcium, aluminium, and sulphur —L Neltner The extension of the Cambrian in south Morocco and the presence in this region of pre Cambrian folds —J Thoulet The Kurosio current of Japan —L Eblé and J Itié The values of the magnetic elements at the station of Val Joyeux (Seine et Oise) on Jan 1, 1929 —Joseph Richard The antherozoids of *Fucus* —Theodureto de Camargo, R Bolliger, and Paulo Correa de Mello The influence of the hydrogen ion concentration of the culture medium on the development of the coffee tree, *Coffea arabica* The coffee plant develops best in acid media, the optimum acidity being between pH 4 2 and pH 5 1 The plant is very sensitive to the action of lime, a very small amount of which is distinctly harmful — W Russell and L Hedin New cisalpine African Leguminoseæ with secretory apparatus —Abeloos The influence of temperature on the growth of the *Planaria* The maximum size is, for given conditions of nutrition, a function of the temperature and decreases notably when the temperature is raised The speed of growth is a maximum at 12° C, smaller at 20° C, and still smaller at 8° C —Pierre P Grassé and Mlle Odette Tuzet The origin and nature of the supposed cephalic skeleton of sperm —G Delamare and C Gatti Spirochætes and treponemes from a venerian granulome

ROME

Royal National Academy of the Lincei, Jan 6 — F Severi and B Segre A topological paradox — G Giorgi The propagation of waves in media with selective absorption By means of an example it is shown how physical phenomena which should depend on matrices of infinite order may be brought back to finite matrices combined with normal functional operators —U Cisotti Certain space integrals in the complex plane —G Fano An example of birational cubic transformation inherent to a linear complex — G Fubini A problem of the theory of the congruences of straight lines, with applications to the problem of the spherical representation of a non Euclidean surface and to a theorem of Bianchi and Blaschke —G A Crocco Considerations on the guiding of an aeroplane in cloud —G Armellini The astronomical refraction at Rome The results of a preliminary measurement indicate that at Rome the refraction constant C has a value slightly greater than 60 154″, and also that this varies somewhat with the season of the year, in virtue of its connexion with other modern astronomical questions, this phenomenon deserves further investigation Application of the method of least squares to the data as yet obtained yields for C the value 60 51″, which lies between the number 60 15″ now adopted by the "Connaissance des Temps" of Paris and that now found at Abbadia, namely, 60 61″, and is, moreover, very nearly in agreement with the old value, 60 44″, given by Radau in the *Annales* of the Paris Observatory —S Franchi The distant re-outcrop at a great height of the inverted nummulitic syncline of Valdieri —E Bompiani Various determinations of the projective normals of a surface — G Vitali Hamilton's principle It is shown that this principle of classical mechanics may be written in a form which satisfies the following two conditions (1) It should render evident the necessary invariance of the integral of which the variation is to be annulled by an invertible substitution on the integration variable, and (2) the system of Euler's equations into which the annulling of the variation of the integral is translated is changed into an equivalent when the integral is subjected to an invertible substitution on the system of four co ordinates constituted initially of three Cartesian co ordinates and of time Further, a proof is given of the known fact that, for slow motions, Hamilton's principle is translatable with sufficient approximation into the system of equations of the geodetics of a space, the linear element of which is expressed by the elements figuring in the ordinary problem and by a constant c sufficiently great —M Previatti Bortolozzi The equivalence of two equations presented in the determination of Vitali's principal terna for a generic surface of Hilbertian space — J Kanitani An intrinsic quadratic form in relation to the hypersurface in projective space of several dimensions —P Barreca Deduction of the experimental law of the duration of twilight colours of the clouds, and the probable discrimination between the theory of a macroscopic diffractive screen (terraqueous globe) and that of microscopic screens (dust) The author has previously shown deductively that the mean durations of the twilight colorations of the clouds are proportional to their respective wave lengths and also to a number relating to the order of the annular spectrum surrounding the globe A proof is now given of the theorem that, if in an isotropic medium there are two punctiform sources of monochromatic light, vibrating persistently from infinite time, and if, further, there are opaque screens of any form but similar geometrically in relation to the respective wave lengths and situated similarly with respect to the sources, these produce diffraction fringes which are geometrically similar and situated similarly —A Belluigi The form of deep, gravimetrically perturbing masses —M Lombardini The viscosity of the air and the constant of surface friction at the experimental station of Vigna di Valle —M Amadori Condensation products of p phenetidine and glucose (2) Investigation of the two condensation products previously obtained shows that the condensation of a primary aromatic amine with glucose gives rise to (1) a compound of glucosidic character formed by the reaction of one hydrogen atom of the amino group with the hydroxyl of the glucose, and (2) a basic compound, resulting from the interaction of two

hydrogen atoms of the amino group with the ketonic oxygen of the aldehydic group or of the lactonic linking of the glucose.—R Altschul New method of impregnation with gold In the impregnation of tissues with gold, the use of mercuric bromide together with gold chloride yields results quite different from those hitherto observed —T Carpanese The pro chlorite of Monte Rosso di Verra (Monte Rosa group) The dehydration of this specimen of prochlorite—which contains little iron—when heated follows a course perfectly analogous to that observed with pennine from Zermatt and with clinochlore from Val Devero The existence of a hydrate containing about 5 per cent of water and stable at 550° 700° C is indicated Re-absorption of moisture from the air proceeds rapidly at first and then gradually slackens and ceases The mineral undergoes optical trans formation when heated, the optic axial angle being annulled and the sign changing to negative, after wards biaxial character is assumed, the mineral re maining negative but with the plane of the optic axes perpendicular to the original position —P Principi Outcrops of 'scaly clay' in Northern Umbria —L De Caro The isoelectric point of myoprotein and the regulating power of muscular juice The regu lating power of the muscle juice of *Emys*, *Scyllium*, and of the electric organ of the torpedo, measured by the ratio $\Delta B/\Delta p\mathrm{H}$, exhibits two minimum values at about $p\mathrm{H} = 7\ 7$ and 5 7 From the former value it increases rapidly on the alkaline side and from the latter on the acid side —B Monterosso Cirrepedo logical studies (5) Anabiosis and revivescence in *Chthamalus* —L Mamoli The adenoid tissue in the normal human lachrymal gland The characters of this tissue, as observed in fifteen living and sixteen dead individuals, varying from a six months old fœtus to an octogenarian, are described —P Pasquini Phenomena of regulation and reparation in the development of the eye of amphibia (results of new experiments on the removal and transplantation of the optical vesicle in *Pleurodeles*, *Axolotl*, and *Rana*) The processes of compensatory regulation during the development of the optical vesicle in these organisms show, in their quality and degree, that this vesicle must be regarded as a specific equipotential and auto differentiable system —L Sanzo Egg and larva of the tunny (*Orcynus thynnus* Ltkn) —B Strampelli Significance of the Heinz Ehrlich bodies, and their relations between macrophagic and myeloplaxic apparatus

Official Publications Received

British

Air Ministry Aeronautical Research Committee Reports and Memo randa. No. 1170 (Ae 334) Report of the Air worthiness of Semi rigid Airships Sub-Committee. (T 2668.) Pp 16+1 plate 9*d* net. No 1188 (Ae. 350) Full Scale Experiments with a Bristol Fighter fitted with Slots and Flaps and Slot and Aileron Control By K. V Wright. (T 2639) Pp. 6+6 plates. 9*d*. net. (London H.M Stationery Office)

Proceedings of the Royal Society of Edinburgh, Session 1928–1929 Vol 49, Part 1, No 5 The General Expression for Boundary Conditions and the Limits of Correlation. By J Ridley Thompson Pp. 65-71 6*d*. Vol. 49, Part 1 No 6 Mental Measurements, the Probable Error of some Boundary Conditions in Diagnosing the Presence of Group and General Factors. By Thomas P Black Pp. 72 77 6*d*. Vol. 49, Part 1, No 8 The Photochemical Equilibrium between Hydrogen, Bromine and Hydrogen Bromide. By R. W Armour and E B Ludlam Pp. 91 101 1*s* Vol. 49, Part 2, No. 9 On the Relation of Fertility in Fowls to the Amount of Testicular Material and Density of Sperm Suspension By F B Hutt. Pp. 102 117 1*s*. 3*d*. (Edinburgh Robert Grant and Son, London: Williams and Norgate, Ltd)

Department of Scientific and Industrial Research Building Science Abstracts. Compiled by the Building Research Station and published in conjunction with the Institute of Builders. Vol. 2 (New Series), No 2, February Abstracts Nos. 201-390 Pp. v+55-95 (London H.M. Stationery Office) 9*d*. net.

Imperial Department of Agriculture for the West Indies. Report on the Agricultural Department, Dominica, 1927–28. Pp. iv+48 (Trinidad.) 6*d*

Board of Education. Vacation Courses in England and Wales and Scotland, 1929. Pp. 96. (London: H.M Stationery Office.) 6*d*. net.

Foreign

Department of Commerce U S. Coast and Geodetic Survey Special Publication No. 150 Tides and Currents in Portsmouth Harbor By A. J Hoskinson and E A. Le Lachaur Pp vi+98 20 cents Special Publication No. 153 Conformal Protection of the Sphere within a Square By Oscar S Adams. Pp 13 5 cents. (Washington D C Government Printing Office)

Ministry of Agriculture, Egypt Technical and Scientific Service. Bulletin No. 77 Preliminary Experiments with Dusting and Spraying against Insect Pests of Cotton By Ibrahim Eff Bishara Pp 11+3 plates. (Cairo Government Press) 5 P T

Proceedings of the United States National Museum Vol 74 Art. 10 Tropical American Diptera or Two-winged Flies of the Family Dolicho podidae from Central and South America. By M C Van Duzee (No 2755) Pp 64+2 plates. Vol. 74, Art. 19 Further Studies of Types of American Muscoid Flies in the Collection of the Vienna Natural History Museum. By J M Aldrich (No 2764.) Pp 34 Vol. 75, Art 8 On some New and Interesting Species of Water Beetles of the Family Gyrinidae in the United States National Museum By Georg Ochs (No 2774) Pp. 6. (Washington D C Government Printing Office.)

Comité National Français de Géodésie et Géophysique Assemblée générale du 2 juillet 1928 Compte rendu publié par le Secrétaire général G Perrier Pp. 59 (Paris)

Catalogues.

Catalogue of Important Works Pre Linnean, Old Herbals and Modern Botany, Birds Microscopy, Fossils Insects and General Literature (No 8.) Pp 16 (London John H Knowles)

The Products of X Rays, Ltd Pp. 104 (London X Rays, Ltd)

Hilger Spectroscopically Standardised Substances (H S Brand) Pp. 4 (London Adam Hilger Ltd.)

Classified List of Second Hand Scientific Instruments (No 94 April) Pp. vi+58. (London C Baker)

Steel Office Furniture (List No 454) Pp. 12 (London G A Harvey and Co, Ltd)

Diary of Societies

FRIDAY, April 26

Royal Sanitary Institute (at City Hall, Cardiff), at 8 —R. M F Picken and E C Williams The New Local Government Act —A N J Sair Some Notes on Town Planning —T H Morris The Proposed Reconstruction Widening and Lowering of Cardiff Bridge

Physical Society (at Imperial College of Science), at 5 —T Smith Dr G F C Searle, Instructor-Capt T Y Baker Dr J W French, W E Williams, C G Vernon H. H. Emsley C W Hansel H Tunley L. Moore, Conrad Beck V T Saunders and Dr C V Drysdale Dis cussion on The Teaching of Geometrical Optics

Royal Society of Medicine (Disease in Children Section), at 5

Armstrong College Mining Society (at Armstrong College Newcastle upon Tyne), at 7 —J S Carson and others Discussion on Iron and Steel Supports in Mines

Royal Institution of Great Britain at 7 —E. A. Salt Platinotype

Institution of Electrical Engineers (Scottish Centre) (at University College Dundee), at 7 30 —W Holmes Load levelling Relays and their Application in connexion with Future Metering Problems

Royal Society of Medicine (Epidemiology Section) at 8.—Dr J G Thomson Endemic Malaria in Southern Rhodesia.

British Psychological Society (Industrial Section) (at National Institute of Industrial Psychology), at 8.—J N Langdon Evidence of a Central Factor in Tests of Manual Dexterity

Royal Institution of Great Britain, at 9 —Prof R. W Chambers English Civilisation from Alfred to Harold, 900–1066

Institute of Brewing (North of England Section) (at Midland Hotel, Manchester).—F M Maynard A Tropical Brewery —H Abbot Some Bottling Notes

Institution of Chemical Engineers (Graduates and Students Section).

SATURDAY, April 27

North of England Institute of Mining and Mechanical Engineers (Associates and Students Section) (at Newcastle upon Tyne), at 2 45 —J T Whetton The Optics of Surveying Instruments and Tacheo metric Surveying

Physiological Society (in Department of Physiology Cambridge), at 3 —F Bremer Contractile Duality of Skeletal Muscle —F D Ingraham and Dr J F Fulton Emotional Disturbances following Experimental Lesions of the Base of the Brain (prechiasmal).—Dr J S. Haldane The Dissociation and Reformation of Oxyhæmoglobin and Bicarbonate in Blood within the Living Body —A J Canny Prof E. B Verney, and Dr F R. Winton The Double Heart-Lung Kidney Preparation —Prof E B Verney and Dr F R. Winton The Action of Caffeine on the Isolated Kidney of the Dog —A. Szent-Györgyi and A N Drury The Influence upon the Heart of Substances related to Nucleic Acid —A Walton The Effect of Temperature on Surviving Mammalian Spermatozoa *in vitro* —J Y Bogue and R. Mendes The Mechanical and Electrical Response of the Frog's Heart.—I. Mazzu Evidence in Favour of the Existence of Depressor Fibres in Secretory Nerves.—H Häusler Hot Wire Analysis of the Effect of Drugs on the Coronary System —Dr G V Anrep, I Mazzu, and J Stella Vaso-motor Reactions of the Coronary System —C W Bellerby (*a*) The Relation of the Anterior Lobe of the Pituitary to Ovulation (*b*) The Physiological Properties of Anterior Lobe Pituitary Extracts.—J M R. Innes and C W Bellerby Spontaneous Deciduomata in the Rat —J S. Patel and B. P Wiesner The β Hormone.—B. P Wiesner Further Studies on Pituitary Extracts —Demonstrations —B H C Matthews A Portable Electrocardiograph.—F Bremer Myographic Records illustrating—(*a*) Summation of Impulses (*b*) Contractile Duality of Skeletal Muscle —J Hammond and Dr F H. A Marshall

A Comparison of the Pseudopregnant and Pregnant Changes in the Ferret.—Prof E D Adrian The Discharge of Sense Organs and of Motor Neurones —A. N Drury and A. Szent-Györgyi The Influence of Adenosine upon the Heart.—A. Walton The Effect of Temperature on Surviving Mammalian Spermatozoa *in vitro* —J R. M Innes and C W Bellerby Changes in the Ovary of the Rabbit following Injections of Anterior Lobe Pituitary Extract.—H Florey and C. W Bellerby Ovulation in the Unmated Hypophysectomised Rabbit.—H B Fell and R. Robison Growth and Differentiation of Explanted Skeletal Tissue.—R. Hill Spectrocolorimeter —H. Florey and Prof J Barcroft, Effect of Exercise on Exteriorised Intestine.—Prof J Barcroft Bottles for Differential Absorptiometer —E. C Smith Critical Limits in the Drying and Freezing of Muscle —H Barcroft The Effect of Adrenalin on the Output of the Heart as Measured by the Mechanical Stromuhr —J Izquierdo Apparatus for Measurement of Effect of Temperature on Pulse of Frog —H Taylor and Prof J Barcroft Effect of HCN on Respiration

MONDAY April 29

Institute of Actuaries, at 5 —J G Parker Financial Conditions in Canada as affecting Life Assurance

Society of Dyers and Colourists (Manchester Section) (Annual Meeting) (at 36 George Street Manchester), at 7 —H H Hodgson Colour and Constitution from the Standpoint of Recent Electronic Theory

Institution of Automobile Engineers (Scottish Centre) (at Royal Technical College, Glasgow), at 7 30 —W P Kirkwood Brakes

Royal Society of Arts at 8 —Sir E Denison Ross Nomadic Movements in Asia (Cantor Lectures) (III).

Royal Geographical Society (at Æolian Hall), at 8 30.—W R. Rickmers The Alai Pamirs in 1913 and 1928

Zoological Society of London (Centenary Celebration) (at University College).

TUESDAY April 30

Royal College of Physicians of London at 5 —Dr F M R. Walshe The Physiological Analysis of some Clinically Observed Disorders of Movement (Oliver Sharpey Lectures) (I).

Illuminating Engineering Society (in Lecture Theatre of Holophane Ltd Elverton Street S W 1), at 6 30 —Dr S. English Some Further Properties of Glass and their Application to Illuminating Engineering (Lecture).—At 8 45 —R G Williams Demonstration of Various Novel Applications of Coloured Light.

Royal Photographic Society of Great Britain (Scientific and Technical Group), at 7 —Dr W Clark A Talk about the Kodacolor Process, with Demonstration —F J Tritton A Method of Increasing the Printing Speed of Dichromated Gelatin

WEDNESDAY, May 1

Royal Institution of Great Britain at 5 —Annual Meeting

Royal Society of Medicine at 5 —Annual General Meeting

Institution of Electrical Engineers (Wireless Section), at 6 —Dr J Hollingworth and R. Naismith A Portable Radio Intensity Measuring Apparatus for High Frequencies.

Institution of Automobile Engineers (Birmingham and Coventry Graduates) (at Queen s Hotel, Birmingham), at 7 30 —H R. Ricardo High speed Diesel Engines

Society of Public Analysts and other Analytical Chemists (at Chemical Society), at 8 —Dr R. S. Morrell and S Marks The Determination of Organic Peroxides —J W Croxford Differential Halogen Absorption of Oils and Fats —Dr W R Schoeller and C Jahn A New Method for the Separation of Small Quantities of Tantalum and Niobium from Titanium —H R. Ambler The Analysis of Small Samples of Gas

Royal Society of Arts, at 8 —P M Horder Architectural Models

Entomological Society of London at 8

Royal Society of Medicine (Surgery Section), at 8 30 —Annual General Meeting

Royal Society of Medicine (Surgery and Medicine Sections), at 8 30 —A. J Walton (Surgery), Dr H Thursfield (Medicine) and others Discussion on The Indications for and the Results of Splenectomy

THURSDAY, May 2

Iron and Steel Institute (Annual Meeting) (at Institution of Civil Engineers), at 10 A M —Presentation of Bessemer Gold Medal to The Hon Sir Charles Parsons.—Prof H Louis Presidential Address —Papers for discussion —First Report on Blast Furnace Plant and Practice by a Committee of the Institute.—E H Lewis Twenty Months Results of Dry Blast Operation —W E Simons The A.I B Sinter Plant at Messrs Guest, Keen and Nettlefolds Ltd Cardiff Works.—At 2 30 —R. H Greaves H H Abram and S. H Rees The Erosion of Guns —H Sutton The Influence of Pickling Operations on the Properties of Steel —G A Hankins and Miss G W Ford The Mechanical and Metallurgical Properties of Spring Steels as Revealed by Laboratory Tests.

Royal Society at 4.—Election of Fellows —At 4 30 —Dr J S Haldane, W Hancock and A. G R Whitehouse The Loss of Water and Salts through the Skin and the corresponding Physiological Adjustments —Dr F H A. Marshall and J Hammond Œstrus and Pseudo-Pregnancy in the Ferret.—R. G Canti and F G Spear The Effect of Gamma Irradiation on Cell Division in Tissue Culture *in vitro* —R. B Bourdillon, C Fischmann, R G C Jenkins, and T A. Webster The Absorption Spectrum of Vitamin D —*Papers to be read in title only* —G E Briggs Experimental Researches on Vegetable Assimilation and Respiration XX —R J Lythgoe and K. Tansley The Relation of the Critical Frequency of Flicker to the Adaptation of the Eye.—R Hill Reduced Hæmatin and Hæmochromogen

Linnean Society of London at 5.—H H Haines Some Aspects of the New Forest, with Special Reference to the Changes Wrought by Direct or Indirect Human Agency —F S Russell A General Account of the Great Barrier Reef Expedition and its Aims.—G Tandy A Preliminary Account of the Vegetation of Low Isles (The Great Barrier Reef Expedition).—H W Pugsley A Revision of the British Euphrasias (*By title only*)

Institute of Pathology and Research (St. Mary s Hospital, W 2), at 5 —Prof C A. Ariens Kappers The Phylogenetic Development of the Protopathic and Epicritic Centres in the Central Nervous System.

Royal College of Physicians of London, at 5.—Dr F M R Walshe The Physiological Analysis of some Clinically Observed Disorders of Movement (Oliver-Sharpey Lectures) (II).

Chemical Society, at 8.—Prof I M Heilbron, W M Owens, and I A Simpson The Unsaponifiable Matter from the Oils of Elasmobranch Fish Part V The Constitution of Squalene as deduced from its Degradation Products —Prof I M Heilbron and A Thompson The Unsaponifiable Matter from the Oils of Elasmobranch Fish Part VI The Constitution of Squalene as deduced from a Study of the Decahydrosqualenes —Prof I M Heilbron and W A. Sexton Studies in the Sterol Group. Part III The Acetylation and Catalytic Hydrogenation of Ergosterol —Prof I M Heilbron, W A Sexton, and F S. Spring Studies in the Sterol Group Part IV The Existence of Isomeric naturally occurring Ergosterols.—Prof. I M Heilbron and F Irving Styrypyrylium Salts Part XI The Determination of the Reactive Group in Ketones of the Type CH_3 CO CH_2R by means of the Benzo β naphthaspiropyran Colour Change.—G A. R. Kon and R P Linstead Catalytic Influences in Three Carbon Tautomerism Part I Sodium Alkyloxides

Royal Society of Medicine (Tropical Diseases Section), at 8 15 —Annual General Meeting

FRIDAY, May 3

Iron and Steel Institute (Annual Meeting) (at Institution of Civil Engineers), at 10 A M —Announcement of the award of the Andrew Carnegie Research Scholarships for 1929 30.—Presentation of the Carnegie Gold Medal to Dr A Bramley —The Hon Sir Charles Parsons and H M Duncan A New Method for the Production of Sound Steel —Third Report on Heterogeneity of Steel Ingots, by a Committee of the Institute —J M Robertson The Microstructure of Rapidly Cooled Steel —D Lewis The Transformation of Austenite into Martensite in a 0·8 per cent Carbon Steel —A. L Norbury Constitutional Diagrams for Cast Irons and Quenched Steels.—At 2 30 —G R. Bolsover Brittleness in Mild Steel —L. B Pfeil The Oxidation of Iron and Steel at High Temperatures —E G Herbert and P Whitaker The Differential Method for Measuring the Thickness of Hard Cases without Sectioning them —T E. Rooney and G Barr A Method for the Estimation of Hydrogen in Steel

Royal Society of Medicine (Otology Section) (Annual General Meeting), at 10 30 A.M —T Neville Treatment of Chronic Deafness by Diathermy and Ionisation

Royal Astronomical Society (Geophysical Discussion), at 4 30 —Cloud Formation C J P Cave Sir Gilbert Walker Chairman, Sir Frank Dyson

Royal Society of Medicine (Laryngology Section) (Annual General Meeting), at 5 —F J Cleminson Treatment of Carcinoma of the Œsophagus by Radium

Philological Society (at University College), at 5 30 —Anniversary Meeting

Institution of Electrical Engineers (Meter and Instrument Section) at 7 —G D Malcolm Chairman s Address

Institution of Mechanical Engineers (Informal Meeting), at 7 —H Berry London s Water

Geologists Association (at University College), at 7 30.—Dr S. W Wooldridge and A. J Bull The Arun Gap and Lower Greensand around Pulborough

Institution of Automobile Engineers (jointly with Institution of Production Engineers) (at Royal Society of Arts), at 7 45 —H F L Orcutt The Production and Application of Ground Gears (Lecture)

Royal Society of Medicine (Anæsthetics Section) (Annual General Meeting), at 8.30 —Dr H Sington Pre medication by Paraldehyde in Children

Royal Institution of Great Britain at 9 —Sir Daniel Hall The Garden Tulip.

PUBLIC LECTURES

FRIDAY April 26.

World Association for Adult Education (16 Russell Square, W C 1), at 8.30.—Miss R M Fleming Soil and Civilisation in Russia.

MONDAY, April 29.

Bedford College for Women at 5.15 —Dr V Stefansson Abolishing the Arctic

University College, at 5 15.—Prof E Mellanby Drug like Actions of some Food Constituents. (Succeeding Lectures on April 30 and May 1)—At 5 30 —Prof H F Baker Geometry a Brief Review (Succeeding Lectures on May 7 and 13.)

WEDNESDAY May 1

Bedford College for Women, at 5 15.—Dr V Stefansson The Northward Course of Empire

THURSDAY, May 2

St Thomas s Hospital, at 5.—Prof S J Cowell Dietetics (Succeeding Lectures on May 9, 16, 23, 30, and June 6.)

University College, at 5 —R. J Lythgoe Special Sense Physiology (Succeeding Lectures on May 9, 16, 23, 30, and June 6)

FRIDAY, May 3

University College, at 4.—Prof A. J Hall Some of the Sequela of Epidemic Encephalitis (Lethargica) —At 5 30 (Succeeding Lecture on May 10)—Prof R. Robinson Public Inaugural Lecture

Imperial College of Science and Technology, at 5.30.—Prof F O. Bower The Origin of a Land Flora reviewed 21 Years after Publication (Huxley Memorial Lecture).

SATURDAY, MAY 4, 1929

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No 3105, VOL. 123]

The New University of London

THE title of this article is not intended to imply any disrespect for the 'old' University of London in any of its previous incarnations In accordance with the new statutes under the University of London Act of 1926, sealed by the Privy Council on Mar 21, the University is going through a process to which the now familiar word 'rejuvenescence' would perhaps be more appropriate than 're birth', for the University, established in 1836, is not old as such institutions go, and shows few of the stigmata of senility But all institutions of the kind live a rhythmical life, and require periodic adjustment to changing conditions This is the third time that the University of London has received special attention from the Government of the day, and we may question whether the proverbial attribute of the 'third time' will be confirmed in this case

The original charter incorporated persons of eminence in arts and science for the purpose of awarding degrees to students of University College and King's College and other colleges which might become affiliated In 1858, a new charter created Convocation and granted to the graduates important privileges in relation to the government of the University At the same time, the system of affiliating colleges was virtually abandoned, being replaced by the policy of the 'open door' In 1900, after a spate of argument, new statutes, based on the Act of 1898, erected the loosely jointed framework of a teaching University, and now, after another spate of argument, the attempt has been made to quicken the life of the University, without altering its essential character

What is the essential character of the University of London? Like its medieval prototypes, it is a self governing guild of teachers, graduates, and students Let us not forget that the medieval university was a research as well as a teaching institution The fellowship system originated in a desire to promote study, and not to promote teaching, indeed, the founder of Queen's College, Oxford, expressly declared that he intended his benefaction to relieve his fellows from the necessity of teaching At Oxford and Cambridge the collegiate system was a later development, an afterthought, due to domestic rather than to educational considerations, and those universities have outgrown the misconception of a university as a federation of colleges, a misconception which impeded their progress for some centuries The present is surely an inopportune moment to force

forward, as some influential members of that University are doing, an alien conception of the University as a "federation of autonomous institutions" It is true that, under the new statutes, the link between the University and its colleges has been strengthened, but the University exists apart from its colleges, and must be free to live its own life, to do its peculiar work for the extension of higher education and research, whether directly or through existing agencies or through new agencies This obligation is emphasised rather than weakened by the new arrangements to be made by the Government and by the London County Council for the allocation by the University of public grants for university education within the London area If the University is to be merely a clearing house for autonomous colleges, it can never hope to gain the public esteem to which the university of the metropolis of the Empire should be entitled

Readers of NATURE are specially interested in the promotion of scientific research, and an application of our thesis is ready to hand One of the current controversies in the University relates to the promotion of scientific research Should it be concentrated in the colleges in close touch with undergraduate teaching or stimulated and developed by the creation of a series of research institutes, as at Cambridge? The best way to deal with a dilemma is often to adopt both alternatives For our part, while recognising that every encouragement must be given to the prosecution of scientific research in the colleges, we are not satisfied that the University will make its due contribution to scientific discovery if it restricts its research work in this way

That we are not discussing the question *in vacuo* is indicated by a report of the Site and Buildings Committee received by the Senate of the University on Jan 23 on the utilisation of the Bloomsbury site of about eleven acres It is proposed to allocate a large part of the area to residential purposes, but the Committee "do not at present propose that the University should build laboratories" There is no evidence that the professors wish to live next door to one another on one of the most valuable sites in the world It is not a London characteristic But if the reference in the sentence quoted from the Committee's report is to laboratories for scientific research, we would urge the new Senate to announce at the earliest moment an intention on the part of the University to build on the Bloomsbury site a great Temple of Science, to use Lord Rosebery's phrase, dedicated to the silent pursuit of scientific truth, a noble counterpart of St Paul's Cathedral As Mr H G Wells has well said, the University of London has "to supply facilities for research upon an altogether unprecedented scale, it has to maintain itself as the intellectual centre of the entire Empire"

The question of the promotion of scientific research will be one of the most important facing the new Senate, now in process of election, and of the subordinate Faculty of Science and Boards of Students Electors, whether teachers or graduates of the University—each category is to contribute seventeen members to the Senate, making together two thirds of the membership—should recognise their serious responsibility in this matter Men and women are required capable of rising above the jealousies and intrigues which have hindered the progress of the University in the past, capable of taking a synoptic view of the needs and problems of university education in London, of pressing steadily forward to a clearly defined conception of the university which London ought to possess

There are many questions relating to the organisation of the new University of London which might be usefully discussed, such as the question of the University area, the work of the University in extending higher education—it is difficult to understand why the vast area of London "across the bridges" is almost *terra incognita* as regards university education—the popularisation of knowledge, the cultivation of art, music, and the drama, the founding of a great school of law, the creation of a great international centre for the exchange of thought and practice, the provision of a great meeting place for conferences of all kinds bearing on education, science, economics, government, national and Imperial development We prefer, however, to stress the importance of the elections to the Senate as the dominating issue at the moment

For the first time in its history the University of London, thanks to the Rockefeller Foundation and to the Government, has its own land on which it can build its buildings and discharge its purposes, not the least important of which is, to quote from the new statutes, "to promote research and the advancement of science and learning" May Henry VIII's wise words, addressed to the University of Oxford, prove true in the case of the University of London "I tell you, sirs, that I judge no land in England better bestowed than that which is given to our Universities, for by their maintenance our Realm shall be well governed when we are dead and rotten"

Travellers' Tales

(1) *The Book of the Marvels of India* By Buzurg Ibn Shahriyar From the Arabic by L Marcel Devic Translated into English by Peter Quennell (The Golden Dragon Library) Pp vi + 164 (London George Routledge and Sons, Ltd, 1928) 6s net

(2) The Broadway Travellers' Series *Hans Staden the True History of his Captivity, 1557* Translated and edited by Malcolm Letts with an Introduction and Notes Pp xx + 191 10s 6d net *Thomas Gage, the English American a New Survey of the West Indies, 1648* Edited with an Introduction by Dr A P Newton Pp xxxii + 407 + 12 plates 15s net *Travels in Persia, 1627–1629* By Thomas Herbert Abridged and edited by Sir William Foster, with an Introduction and Notes Pp xl + 352 + 13 plates 15s net (London George Routledge and Sons, Ltd, 1928)

(3) *Adventures of an African Slaver being a True Account of the Life of Captain Theodore Canot, Trader in Gold, Ivory, and Slaves on the Coast of Guinea, his Own Story as told in the Year 1854 to Brantz Mayer, and now edited with an Introduction by Malcolm Cowley* Pp xxii + 376 + 9 plates (London George Routledge and Sons, Ltd, 1928) 15s net

WHY is it that nine out of ten modern books of travel are intensely dull and yet early travels never seem to fail in their appeal to the imagination or their hold on the attention of the reader? This is equally true whether they break what, in their author's time, was new ground, or follow a beaten track In all these books under notice there is scarcely a dull page

(1) 'The Book of the Marvels of India" calls for no extended comment, though it is infinitely entertaining It is a collection of stories current among Arab seafarers in medieval times, full of marvels described with a wealth of detail and here and there a sly touch of humour It was obviously on some common stock that the authors of Sindbad in the "Arabian Nights," of Sir John Mandeville, the author of this collection, and other writers of similar tastes, drew for their accounts of the wonders of the East The roc, the old man of the sea, the island of women, and other familiar marvels, will be found here, but in such a form as not entirely to preclude a remote foundation in reality

(2) This, with the two volumes mentioned next in order, is issued in the excellent series of Broadway Travellers, for which we are indebted to the scholarship of Sir E Denison Ross In this series the travels selected for publication have been chosen with much discrimination, while in illustration, type, and form, the series as a whole is very pleasing

Hans Staden's account of his captivity among the Indians of Brazil is a remarkable document A Dutchman of the middle sixteenth century who served the Portuguese as a gunner he visited Brazil twice, being captured on the second occasion The Indians, whom he usually but not invariably calls Tupinambu, made a practice of eating their prisoners if they were Portuguese Staden barely escaped that fate He gives a unique account of the details of their method of procedure

Thomas Gage, the author of the 'English American,' was a man of very different type Educated as a Jesuit in France and Spain, he became a Dominican and went to America, where he stayed for twelve years as a missionary His book written on his return to England, was the first authentic account of Spanish America and the West Indies to be written in English It had a great vogue in the seventeenth century, dropped into oblivion, and had not since been reprinted This was no doubt due to the fact that, the author having changed his religion, his theological polemic as well as his narrative were used by the Commonwealth as propaganda against Spain and caused the very real merits of part of his work to be forgotten The editor has judiciously excised those parts of his book which make no appeal to the modern reader

Gage was scarcely an admirable character—he acted as informer against his former co religionists—and it is characteristic of the man that he expects much of what he has to say not to be believed

Herbert, author of 'Travels in Persia," accompanied Sir Dodmore Cotton on the embassy to Shah Abbas in 1627, and was thus the precursor of Tavernier, de Chardin, and other great travellers of the seventeenth century He returned to England in 1629, and published his book in 1633 He afterwards issued several enlarged editions The book is of considerable historical importance, as it is the only detailed account of the first English embassy to Persia Herbert had a good opportunity of seeing something of the country, as not only was the embassy compelled to make a stay of some length, but also, owing to the absence of the Shah from his capital on their arrival, they had to follow him so far as Kasvin Herbert was an acute, if not very profound, observer, and gives a very good account of the Persia of that day His

observations of the peoples seen at the ports at which they touched on the voyage around the Cape are also of considerable interest

(3) "Adventures of an African Slaver" is noteworthy as a graphic account of conditions in the slave trade in the earliest part of the nineteenth century when it had been prohibited, transcribed from the oral narrative of the protagonist by an American journalist It is absorbing, if rather horrifying, as a story and valuable as a historical document

The Movements of Plants

The Motor Mechanism of Plants By Sir Jagadis Chunder Bose Pp xxv + 429 (London, New York and Toronto Longmans, Green and Co, Ltd, 1928) 21s net

IT is safe to assume that there are certain fundamental resemblances in the behaviour of all living cells in virtue of their possessing the same ground plan of protoplasmic structure, and among all aerobic cells in virtue of a similar oxidative mechanism, as the recent work of Keilin suggests Among all animal contractile cells, again, there are general resemblances When, therefore, we consider the observations of Sir Jagadis Bose on plant movements from the point of view of general physiology, we have to decide whether the resemblances he finds are merely common properties of living protoplasm as such, or of excitable protoplasm, or contractile protoplasm, and whether there are specific differences between the processes of animal and plant

In the present work, as in all the work of Sir Jagadis Bose, the apparatus and methods used combine delicacy and simplicity in a delightful way For example, nothing could be neater than the various types of tapping recorder described on pp 16 28, for writing without friction on a smoked surface and in the same process making a time record Another ingenious device is the 'quadrant' method for recording the change in electrical resistance of a leaf on exposure to light (p 194) A circular leaf is connected up to a battery and galvanometer by four leads so that the leaf is divided into quadrants, each of which forms one arm of a Wheatstone's bridge By adjusting the position of one contact the bridge resistances are balanced Two opposite quadrants can be exposed to light while the others are kept in the dark by a screen cut to the correct shape If the illuminated quadrants vary in resistance, the galvanometer deflection will be proportional to the product of the changes, so that a method of high sensitivity is obtained with a minimum of apparatus

The use of this device illustrates the chief defect in this work, the lack of experimental controls The galvanometer deflections are taken at their face value as measuring change of resistance without any inquiry as to whether the 'action current' of the excited tissue may not be a complicating factor So far as the description goes, this method, and another one mentioned, may be simply rather roundabout ways of recording the action current The great similarity of the curves in 'resistance' and of electrical change lends colour to this suspicion

Some other points in the book where similar criticism is called for may as well be dealt with at once Be it understood that criticism is directed solely against the case as presented in the volume under notice, Sir Jagadis must not blame the reader for ignoring other evidence which is not quoted The first case is the use made of the very ingenious magnetic method for magnifying the movement of a lever By this method a movement can be magnified ten million times (p 346) At this magnification temperature control to 0 01° C would seem to be called for, but no indication is given that a thermostat was used at all Using this instrument, an oscillatory response was obtained in stems in which there was an active flow of sap The oscillations might have been due to the natural period of the instrument They were probably not, but no evidence is given on the matter Again, if the oscillations are genuine their period should correspond with that of the electrical changes described previously, and changes in amplitude should be in the same direction in both cases, but no information of this sort is given, so that the results must be accepted with reserve

In Chapter ix experiments are described on excitation with constant current Owing to the slow conduction of excitation, it is easy to see from which electrode the excitation process starts in any plant that makes an obvious movement With currents near the threshold potential, excitation occurs at the cathode at the make of the current only, with rather stronger currents up to about twice the threshold value, excitation occurs also at the anode at the break This is strictly according to the behaviour of animal tissues With stronger currents, however, there is excitation also at the anode at the make, with stronger still at the cathode at the break If these results were taken at their face value, as the author intends them to be, they would imply the existence of a new type of excitation process, but the data do not warrant such an extreme

conclusion When a current is passed through a tissue with cells arranged in series as well as in parallel, each cell in the region of the flow has a cathodal and anodal region With weak currents a few cells only near each external electrode will be subjected to a potential approaching the threshold value, and the probability is that cells near the external cathode will experience the highest potential at their cathodal end and those near the anode at their anodal end, and will be excited accordingly With potentials above that required to excite at the external anode at the break, some of the cells near the external anode may have local cathodes at which excitation occurs, and correspondingly near the external cathode There is no reason to doubt the observations, but good reason to doubt the naïve conclusions drawn from them

In several of the experiments described in Chapters xiii and xiv, which deal with the electric response on stimulation, positive galvanometer deflections were found as well as negative These positive deflections are interpreted as genuine action currents in the opposite direction to the usual action current In every case, apparently, both electrodes were placed on functional tissue, but as one was in contact with a more obviously active region, it is assumed that all galvanometer deflections were due to changes in that region, and that no changes occurred elsewhere that could affect the other electrode This seems a rash assumption, and it is a pity it was apparently not tested, as it easily could have been by placing the second electrode on killed tissue It is true that several observers have claimed to find positive electrical changes in the heart when it is inhibited by stimulation of the vagus nerve, but the interpretation of the results is not clear and the case is a special one

Turning now to the more grateful task of summarising the chief positive results there is clearly a fundamental similarity between the processes of excitation and conduction in plant and animal, but certain interesting differences The actual contractile process in the plant seems to be different Two main types of movement have been investigated The first is leaf movements, such as those of *Mimosa pudica*, which are compared with the response of skeletal muscle, and the rhythmical movements of *Desmodium gyrans*, which suggest those of heart muscle The other type is the process of sap propulsion in the stem As the same tissue is concerned in leaf movement and sap propulsion, it would seem natural to look for a connexion between the two processes, this possibility the author does not, however, discuss

The leaf movements of *Mimosa* can be studied either in the intact plant or in isolated preparations The tissue is very sensitive to electrical stimulation by single induction shocks Torsion of the stem and other mechanical stimuli are effective, as can be shown by the electrical response Light can act as a stimulus to *Mimosa*, and the plant is more excitable when illuminated, so much so that a cloud passing across the sun will cause a diminished response to electrical stimulation Subliminal stimuli become effective on repetition The contraction occupies about one second after a latent period of one tenth of a second Relaxation takes several minutes The tissue is refractory after stimulation It is readily fatigued and shows a ' staircase ' effect with a few successive stimuli

The character of the phenomena, particularly the slow response, together with sensitivity to electric currents of short duration, does not suggest the behaviour of an isolated muscle or muscle nerve preparation, but something more like a reflex, where the sensitivity and speed of reaction of the receptor mechanism need not resemble that of the effector mechanism Comparison with reflex processes in vertebrates cannot be ruled out, but a closer analogy is probably to be found in such a reflex, if it can be so called, as the retraction of the syphons of the clam (*Mya arenaria*) on exposure to light or other stimuli (cf Hecht, *Jour Gen Physiol*, vols 1 and 2)

The movement in question consists of contraction of certain cortical cells of the leaf joint There is a large body of active cells on the lower side the contraction of which generally masks the feebler action of the cells on the upper side, consequently, the normal movement on stimulation is a fall of the leaf, but under suitable conditions an active erection can be demonstrated The contraction, unlike the animal contractile process, consists of a diminution of volume, whereby sap is squeezed out of the cells This accounts for the slowness of the relaxation, which is governed by the uptake of sap With excessive turgor the movement is diminished or even abolished, though the electric response remains (p 168) In the dark the leaf preparation or plant becomes excessively turgid—' subtonic,' the author calls the condition In this state the first stimulus applied elicits only a small erectile response, with successive stimuli the opposite and normal response gradually reasserts itself The phenomena appear to be sufficiently accounted for if we consider that turgor merely masks the response of the cells, makes them contract isometrically, and affects the cells of the lower side more than those of the upper,

as is indicated by a greater erection than usual With repeated stimulation the turgor is gradually worked off

Sir Jagadis, however, considers (pp 48 56 and 233 237) that the energy of the stimulus has not merely a trigger action but may also contribute to the available potential energy of the tissue, that the 'subtonic' condition is one of lowered potential energy, and that an erectile response involves an increase of potential energy (what if the plant be turned upside down?) Let it suffice to say that the theory, if the reviewer has not misunderstood it, would imply that the mechanism of plant movement is utterly unlike anything found in the animal kingdom

Experiments are described showing that the effect of many drugs on muscle and on plant response are similar, but the work is of less importance than it might have been had the drugs been more judiciously selected It is not specially interesting to be told that general protoplasmic poisons such as ether or sulphuretted hydrogen depress activity, because one could have predicted as much With such nonspecific agents, quantitative comparison of the susceptibility of different cells would be of interest, but not a merely qualitative comparison Of much greater interest are the few experiments quoted on the action of specific drugs, such as those showing a similar action of muscarine, pilocarpine, and atropine on frog's heart and the movements of *Desmodium* (p 269)

As the contractile process is essentially a reduction in volume of the active cells, the diameter of a leaf stalk or a stem will be slightly diminished on stimulation This change has been measured by means of a high magnification lever system (Chapters xi and xii) In the leaf stalk of *Mimosa* all the cortical cells appear to be active, consequently the contraction of a single cell can be calculated With maximal stimulation the change in diameter of the cell is 13 per cent, which implies a volume change of about 35 per cent if contraction is uniform in all directions The method of measuring the change in diameter on stimulation enables the activity of many plants which make no obvious movements to be investigated A contractile process can be demonstrated in many common plants, such as the bean and *Impatiens* The recorded movements are small and slow, and the latent period is long, but the difference between 'active' and 'inactive' plants is clearly a matter of degree The inactive plant contains fewer or less developed contractile cells, but some active cells have been shown to be present in many herbaceous plants and shrubs This is not surprising if we accept the author's further contention that sap propulsion is due to a contractile mechanism in the cortex If the excitation process spreads along a stem, the effect of successive contraction of cortical cells is bound to be a forward movement of sap, if a considerable number of cells in one region can be excited simultaneously and they are predominantly on one side of the structure, the effect will be a movement of the structure as a whole

Sir Jagadis Bose argues convincingly against the view that the ascent of sap is due solely to the action of the roots and leaves, while the rest of the plant is passive and is only a system of tubes By several different experimental methods he shows that there is a flow of sap in isolated stems and an active process in the cortex (Chapters xxii xxix) It is possible to object to his use of the term 'peristalsis' for the sap pumping process, as the analogy has not been demonstrated except in a vague way, but the objection is of no great moment Propulsion of sap is found to be a normal response to stimulation The direction of flow is always from an excited region to an unexcited region, but the pressure produced by propagation of the excited state in the normal direction is about four times as great as that produced in the opposite direction The active tissue is identified as cortical by exploring with a needle electrode until the place of maximum electric response is found

Something ought to be said of the performance of *Desmodium gyrans*, the telegraph plant (Chapter xix) Under normal stimulation by light, the leaflets keep up a rhythmic movement with a period of two minutes or so In the dark these 'spontaneous' movements cease after a time, but the plant can be excited electrically or by a light With a weak stimulus it will give a single response, with stronger stimulation a series Apparently other plants will give several responses with moderately strong stimuli, but *Desmodium* is more excitable, less readily fatigued, and shows this phenomenon of 'after discharge' in a far more striking manner It is remarkable to find still another character of the motor response of plants suggestive of reflex movement in animals

For the investigation of processes of excitation and conduction, and of some peculiar types of contractile process, the vegetable kingdom evidently offers very great scope All those interested in these aspects of general physiology will be grateful to Sir Jagadis Bose for his pioneer work, and for the extraordinarily ingenious methods he has devised A D Ritchie

Kinetic Theory and Electric Conduction through Gases

Conduction of Electricity through Gases By Sir J J Thomson and Prof G P Thomson Third edition Vol I *General Properties of Ions, Ionization by Heat and Light* Pp vi+491 (Cambridge At the University Press, 1928) 25s net

THE Geissler tubes and Crookes tubes that were in almost every physical laboratory at the end of the last century enabled any student to observe with ease the fascinating phenomena of electric discharges in gases at low pressures These and the newly familiar phenomena of radioactivity and X rays made the theory of electric conduction through gases appear to be of bewildering complexity

One of the most remarkable chapters in scientific history is that of the development of our knowledge of these phenomena Perhaps the greatest single factor responsible for the rapidity of the progress was the publication in 1903 and 1906 of the first and second editions of Sir J J Thomson's book The world wide interest thus aroused by these discoveries, which had originated so largely in the Cavendish Laboratory, has had a profound effect on almost every branch of modern physics

The great influence of the book was due not so much to the importance of the discoveries which it described, as to the fact that it was in itself a new scientific contribution The results of previously published investigations were discussed in a most critical, but constructive, manner, frequently new points of view were developed and new or improved methods of experimental investigation were suggested For example, on p 222 of the second edition in proposing a method for determining e/m, differential equations were derived which were applicable to the potential distribution in a pure electron discharge in high vacuum When in 1912 the experimental conditions for obtaining pure electron discharges limited by space charge were found, it was only necessary to perform one more integration of Thomson's equation and introduce the boundary condition $dv/dx=0$ at the cathode to derive an equation for the relation between current and voltage in devices having discharges of this character

The spirit in which the book was written is best illustrated by the first and third paragraphs of the preface to the first edition

" I have endeavoured in this work to develop the view that the conduction of electricity through gases is due to the presence in the gas of small particles charged with electricity, called ions, which under the influence of electric forces move from one part of the gas to another My object has been to show how the various phenomena exhibited when electricity passes through gases can be co ordinated by this conception rather than to attempt to give a complete account of the very numerous investigations which have been made on the electrical properties of gases I have, therefore, confined myself for the most part to those phenomena which furnish results sufficiently precise to serve as a test of the truth of this theory

'With the discovery and study of Cathode rays, Rontgen rays, and Radio activity, a new era has begun in physics, in which the electrical properties of gases have played and will play a most important part the bearing of these discoveries on the problems of the Constitution of Matter and the Nature of Electricity is in most intimate connection with the view we take of the processes which go on when electricity passes through a gas '

The methods of analysis which were used in the book are essentially a development of the classical methods that Maxwell employed in his development of the kinetic theory

In the twenty two years that have elapsed since the publication of the second edition, our knowledge in this field has been increasing at an ever accelerating pace Furthermore, industrial applications of the utmost importance, especially in telephony and radio communication, have been built upon the foundations laid by Thomson New and even more important applications are almost within sight

The advent of the third edition of this book must thus arouse extreme interest It is not surprising that there are now to be two volumes The preface by Sir J J Thomson says 'The preparation of this Edition was commenced some fifteen years ago and some of it was in type when the War broke out The publication of this Edition is due to my having had the co operation of my son, Professor G P Thomson, who has done most of the work required for its preparation "

The spirit and plan of the new edition are essentially the same as those of the earlier ones, even the numbering of the paragraphs is the same The preface says

We have adopted a decimal notation for numbering the paragraphs, those that were in the Second Edition are denoted by integers, and those dealing with subjects cognate to the original paragraph by this integer followed by a decimal Most, though not all, of the original paragraphs have been retained, a few in shortened form Otherwise little alteration has been made in them beyond replacing the values of the fundamental constants by the more accurate ones obtained since the publication of the earlier editions "

The nomenclature has been changed to accord with modern practice, using 'electron' in place of 'corpuscle' or 'negative ion,' and 'X rays' instead of 'Röntgen rays'

The new volume, in 482 pages, covers the ground of the first ten chapters of the second edition, which there required 290 pages The material of about 240 pages out of these 290 is used in the new edition with only minor changes Thus about one half of the new volume is wholly new material It has naturally been possible to cover adequately the work of the last twenty two years only by restricting the subject matter rather closely to the title "Conduction of Electricity through Gases" instead of dealing with the broader field of electric discharges in gases

In Chapter i, dealing with the conductivity of gases in a normal state, five pages are added covering recent research on the penetrating radiation "coming from the sky" In speaking of the uncertain origin of these radiations it is stated (p 12) "It would be one of the romances of science if these obscure and prosaic minute leakages of electricity from well insulated bodies should be the means by which the most fundamental problems in the evolution of the cosmos had to be investigated"

The subject of the mobility of ions, which occupied 38 pages, or about half of Chapter ii in the second edition, is now treated in a separate chapter of 108 pages Eleven methods, including the recent ones of Tyndall and Grindley, and of Laporte, are discussed at length, and there follows an excellent treatment of the theory of mobility and its dependence on pressure, temperature, impurities, and the sizes and masses of the ions

Ten pages are devoted in Chapter vi to an account of Thomson's early work on positive ray analysis, followed by 14 pages on Aston's further development of the mass spectrograph and a discussion of isotopes In Chapters vii and viii, ten pages are given to Millikan's determination of e and five pages to C T R Wilson's cloud tracks of ions

Chapter ix, on ionisation by incandescent solids, has been increased from 40 to 61 pages, much less than might seem warranted by the great development in this field After dealing with the effect of space charge on pure electron currents in high vacuum, there follows on p 374 a discussion of the effects to be attributed to the initial velocities of the electrons from the cathode This is treated as a problem of the diffusion of the electrons It seems to the reviewer that the concept of diffusion of electrons in high vacuum (such as that for which the 3/2 power law applies) is not appropriate in this case, and that the only proper treatment is one of the type that has been given by Epstein, Laue, Fry, and the reviewer in various publications on this subject

As the plan of the book is an application of the classical kinetic theory to the phenomena of gaseous conduction, it is natural that no attempt is made to treat the collisions of electrons with atoms or ions from the point of view of the quantum theory Critical potentials are mentioned practically only on p 472 in a comparison of Townsend's data on ionising potentials with those obtained by the Frank and Hertz method Quanta are mentioned only in connexion with photoelectric effects involving the Einstein equation On pp 57 59, a theory is derived for the energy which an electron loses in colliding with a molecule, based upon the classical assumption that an electron in the molecule has a definite period of vibration, so that the impinging electron transfers a variable amount of energy to the vibrating electron

The present value of the classical methods is, however, in general amply demonstrated by this book, and by the numerous cases where the more rigorous methods of the new mechanics have not yet been or cannot yet be applied to the solution of practical problems The book is to be thoroughly recommended not only to those interested in the historical development and the present status of the subject matter, but also to those who still desire to have 'physical pictures' to aid them in understanding phenomena IRVING LANGMUIR

Our Bookshelf

An Introduction to Organic Chemistry By Prof Alexander Lowy and Dr Benjamin Harrow Second edition Pp xiv+407 (New York John Wiley and Sons, Inc, London Chapman and Hall, Ltd) 15s net

THE second edition preserves the general character of the original Although not sufficiently didactic for use as a vade mecum for junior students of organic chemistry, it should be of value as a supplement to lecture courses and experimental work Some of the numerous tables and summaries are possibly overburdened with detail, while in other instances the treatment is unduly laconic For example, the isomerism of maleic and fumaric acids is indicated by means of two formulæ with a footnote "It is suggested that the instructor show this type of isomerism with the Kekulé [sic] models" An exposition of spatial isomerism, even with the aid of an instructor and Kekulé models, leaves something to be desired

Although the carbohydrate chapter has been revised and enlarged, there is no reference to the δ oxide formula for glucose, moreover, the repre-

sentation of lactose with a formal aldehyde group is somewhat misleading The book contains a number of useful indications of the connexion between organic chemistry and medicine, pharmacy, dentistry, agriculture, and the biological sciences There is adequate mention of up to date methods of preparing various organic substances in common use, but it is surprising to find, in a modern text book, the terms 'diatomic,' 'triatomic,' and 'polyatomic' applied to alcohols The type and paper are of excellent quality, the portraits of eminent organic chemists, however, are not well reproduced J R

Laboratory Methods of Inorganic Chemistry By Heinrich Biltz and Wilhelm Biltz Authorised translation by William T Hall and Arthur A Blanchard Second edition Pp xv+261 (New York John Wiley and Sons, Inc, London Chapman and Hall, Ltd, 1928) 12*s* 6*d* net

The first edition of Biltz was very favourably received, and the present edition is an improvement on the previous one New preparations have been added and the older ones revised The short theoretical sections are also very good, especially that on the periodic system, in which atomic structure is included In most undergraduate courses the amount of practical inorganic chemistry, apart from qualitative analysis, is usually much too small in comparison with the practical organic chemistry, and there is sometimes a danger that the course will lack balance and become one sided Any idea that inorganic preparations do not offer so much scope for manipulative skill as those in organic chemistry will quickly be dispelled by looking through the present volume, in which a number of more difficult preparations are included These are in many cases suitable for students who have completed an ordinary course and wish to do more advanced work without actually embarking on research

The book will also be found most useful by students beginning research in inorganic chemistry, and by teachers who wish to introduce inorganic preparations into the more advanced courses It may be recommended to all these as the only work of its standard in existence When the large amount of material presented is taken into consideration, the price is very reasonable indeed

Che cos' è l' elettricità? Per Giovanni Giorgi (Collezione Omnia, 8) Pp 136 (Roma Paolo Cremonese, 1928) 6 50 lire

The latest developments of physical theories point not only to the possibility of a complete change in our conception of the nature of matter, but also in our views of causality and natural law They are no longer purely mathematical and experimental Speculations are being made in regions formerly regarded as metaphysical and outside the limitations of human knowledge No one can say where these speculations will lead us Recent theories, however, are becoming more acceptable to the average physicist Electrons and protons appearing as energy centres in so-called material waves remind us of the vortex rings which were much studied fifty years ago

G Giorgi, in this interesting little book, gives us a clear résumé of the opinions held as to the nature of the phenomena of electricity, beginning with Du Fay in 1733, and ending with de Broglie, Schrödinger, Dirac, and Heisenberg Practically no knowledge of mathematics is assumed, so this book will be appreciated by the layman as well as by the scientific worker No one can claim to have a general knowledge of science who is ignorant of these theories If they are as important as many physicists believe them to be, then the sooner they come up before the general tribunal of mankind the better

Leaf Mining Insects By James G Needham, Stuart W Frost, and Beatrice H Tothill Pp viii+351+5 plates (London Baillière, Tindall and Cox, 1928) 27*s* net

The authors mention that the object of this book is to provide a non technical introduction to leaf-mining insects, an account of their biology and lists of miners, together with their host plants Four orders of insects, namely, Coleoptera, Lepidoptera, Hymenoptera, and Diptera, include species which have developed leaf mining habits in their larval stages This type of behaviour attains its greatest development in Lepidoptera, and about one half of the volume is consequently devoted to these insects The various grades of mining habits are discussed, and the correlation between structure and function clearly stressed in different types of larvæ Although the subject is a specialised one, the knowledge brought together by the authors shows that the study of leaf miners offers many features of interest to the ecologist and to the student of adaptation At the same time, the field naturalist and economic entomologist will find the book of material help in the identification of the species found, more especially in North America The subject matter is well arranged, the illustrations are for the most part adequate, and there is a useful bibliography provided at the end We can recommend the book as a useful introductory manual

The Cellulose Lacquers a Practical Handbook on their Manufacture By Dr Stanley Smith Pp ix+145 (London Sir Isaac Pitman and Sons, Ltd, 1928) 7*s* 6*d* net

The cellulose lacquer industry is one of great importance, and the manufacture and applications of these materials are advancing at a rapid rate The present manual is written from the practical point of view The style is often rather discursive, and although the author remarks that he will avoid technical terms so far as possible, this is no reason why he should not spell correctly those which he uses, 'phthallate' occurs several times The account covers the whole subject, including raw materials, formulæ, plant, pigments, methods of application, and the industrial applications The book is well printed and illustrated, and it will be found useful to those actually engaged in the industry

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

A Proposed Modification of Einstein's Field-Theory

IN previous issues of NATURE[1] mention has been made of Einstein's recent field theory, intended to combine in a compact geometrical model the mathematical representation both of gravitation and of electromagnetism.

The original essay of Einstein is based upon a special covariant derivation and absolute parallelism (already introduced by Prof. Weitzenböck and, independently, by Prof. Vitali), and leads to the construction of two sets of relations, one of which corresponds exactly to Maxwell's theory, whilst the other reproduces the celebrated Einstein's gravitational equations, though only to a first approximation.

I have remarked that Einstein's model may be more completely and satisfactorily attained without abandoning the usual lines of absolute calculus, and, above all, rigorously accounting for both Einstein's and Maxwell's equations. A full exposition of this method with correlated mathematical developments is now in print in the Berliner *Sitzungsberichte* (by the kind transmission of Prof. Einstein). I take the liberty of resuming here my improvement, Einstein's procedure itself having been outlined some weeks ago in the article by Prof. Eddington already quoted.

The support of the model is still the space time V_4, that is, a Riemannian four dimensional manifold which embodies space and time; but something is to be added to the topological attributes of this fourfold continuum, and to the expression of its metrics

$$(1) \qquad ds^2 = g_{\mu\nu}dx^\mu dx^\nu$$

in general co ordinates x^0, x^1, x^2, x^3.

To obtain a convenient filling we first recall some fundamental notions of differential geometry. A direction function of the point (x^0, x^1, x^2, x^3) may be defined by means of the corresponding parameters $\lambda^\nu (\nu = 0, 1, 2, 3)$, that is, four numbers which are proportional to the increments dx^ν of the x^ν in the given direction, the factor of proportionality being fixed (if we exclude the directions of zero interval along which $g_{\mu\nu}dx^\mu dx^\nu = 0$) by the quadratic condition

$$(2) \qquad g_{\mu\nu}\lambda^\mu\lambda^\nu = 1.^{2}$$

The differential equations

$$\frac{dx^0}{\lambda^0} = \frac{dx^1}{\lambda^1} = \frac{dx^2}{\lambda^2} = \frac{dx^3}{\lambda^3}$$

define a family of lines, called congruence, such that a line of the family passes through every point of the V_4 in the direction λ.

Now we may provide our V_4 with a fourfold diagram, *world lattice*, by introducing not only one only, but also a set of four congruences which intersect each other at right angles. If their parameters are denoted by $\lambda_i{}^\nu$ (i order suffix, ranging from 0 to 3), we must have, combining (2) with the condition of perpendicularity,

$$(3) \qquad g_{\mu\nu}\lambda_i{}^\mu\lambda_k{}^\nu = \delta_{ik} \qquad (i, k = 0, 1, 2, 3),$$

where δ_{ik} has the usual meaning (0 if $i \neq k$, and 1 if $i = k$).

When the $g_{\mu\nu}$ are given, equations (3) represent $4 \cdot 5/2 = 10$ conditions to be satisfied by the 16 parameters $\lambda_i{}^\nu$. But, as the $g_{\mu\nu}$ are exactly as many as the equations (3), we may also regard (3) as the definition of the $g_{\mu\nu}$, that is, of the metrics of V_4, the 16 quantities $\lambda_i{}^\nu$ being taken at will, with the only restriction that the determinant $\|\lambda_i{}^\nu\|$ does not vanish. It is, more over, very easy to solve explicitly the (linear) equations (3) with respect to the $g_{\mu\nu}$. Denoting by $\lambda_{i/\nu}$ the reciprocal element of $\lambda_i{}^\nu$ in the determinant $\|\lambda_i{}^\nu\|$ (that is, the algebraic complement, or minor, of $\lambda_i{}^\nu$, divided by the determinant itself), we have

$$(3') \qquad g_{\mu\nu} = \sum_0^3{}_i \lambda_{i/\mu}\lambda_{i/\nu}.$$

Our task is to show that the 16 quantities $\lambda_i{}^\nu$ (and, with them, all the features of world lattice) may be determined by means of the field equations. From a mere formal point of view such a requirement is quite allowable. Indeed, the gravitational equations are in number *ten* (as many as the $g_{\mu\nu}$). On the other hand, Maxwell's system involves (besides the $g_{\mu\nu}$) the six elements $F_{\mu\nu}$ of an anti symmetrical tensor, which define simultaneously the electric and the magnetic force. The system is formed by eight equations, bounded, however, by two differential identities, so that only *six* are independent; and effectively they are able, as is well known, to determine the $F_{\mu\nu}$ uniquely from their initial values. As $10 + 6 = 16$, we have exactly as many equations as there are $\lambda_i{}^\nu$. But in what sense and manner do these equations contain our $\lambda_i{}^\nu$ (and no other unknown quantity)?

The answer is obvious, or even forced, in regard to the gravitational equations, for they are essentially partial differential equations of the second order in the $g_{\mu\nu}$; hence, by (3'), we may regard them as well as 10 differential equations for the $\lambda_i{}^\nu$, which contain, moreover, like the Maxwellian equations, the six components $F_{\mu\nu}$. In order to get relations involving only the geometrical quantities $\lambda_i{}^\nu$, we must connect in some way the F's with the λ. From an abstract point of view this may be done arbitrarily, with the only condition that the six new equations, thus arising from the Maxwellian ones, are independent one of another, and, together, of the ten former, which implies, among other things, that the $F_{\mu\nu}$ cannot be combinations of the $g_{\mu\nu}$ alone.

I propose to put

$$(P) \qquad F_{\mu\nu}\lambda_i{}^\mu\lambda_k{}^\nu = \upsilon\sum_0^3{}_l \frac{d\gamma_{ikl}}{ds_l},$$

where υ denotes a constant, $\frac{d}{ds_l}$ the operator $\sum_0^3{}_\nu \lambda_l{}^\nu \frac{\partial}{\partial x^\nu}$, and the γ_{ikl} are the *Ricci's coefficients of rotation* of the set of congruences to be determined. Their explicit expressions are well known; at any rate it may be remembered that they follow immediately from the equations

$$(4) \qquad \gamma_{lik} - \gamma_{lki} = \sum_0^3{}_\nu \lambda_{l/\nu}\left(\frac{d\lambda_k{}^\nu}{ds_i} - \frac{d\lambda_i{}^\nu}{ds_k}\right),$$

$$(5) \qquad \gamma_{ikl} + \gamma_{kil} = 0 \qquad (i, k, l = 0, 1, 2, 3).$$

I shall not enter into details concerning the features of the position (P) itself, or of its consequences as transformer of the Maxwellian equations in pure geometrical ones. I content myself with a hint to the limiting case of empty space.

It has been a starting point in the original discovery of Einstein's gravitational equations (and was after-

[1] Compare especially the brief but striking account by Prof. Eddington in NATURE of Feb. 23, pp. 280-281, and the letter from Messrs. Wiener and Vallarta in the issue of Mar. 2, p. 317.

[2] Since the ds^2 of general relativity is indefinite, the condition (2) may very well introduce imaginary λ's. We allow them here for brevity; but in my paper it is shown how any appearance of imaginaries may be avoided in the very appropriate manner systematically worked out by Prof. Eisenhart in his "Riemannian Geometry" (Princeton University Press, 1926).

wards mathematically proved by Serini) that, if the energy tensor is zero throughout all space, and singularities are excluded, this is necessarily Euclidean Now what will be the set of congruences in such an empty space, that is, a space where not only material masses, but also electromagnetic forces are absent ?

Our position (*P*), for $F_{\mu\nu}=0$, leads almost immediately to the conclusion that, *in empty space, the world lattice is Cartesian* Any intervention of material or electric phenomena carries, on the contrary, some distortion of world lattice with it

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Mar 18

The Primary Process in the Formation of the Latent Photographic Image [1]

IN two brief notes to NATURE (120, 441, 1927 121, 865, 1928), it was shown by one of us that the mechanism taking place during the formation of the latent photographic image in silver bromide emulsions must be closely connected with that causing the photo-conductivity effect (that is, the decrease of resistance on illumination) in silver bromide prepared free from gelatin and other substances present in commercial emulsions

The complete building up of the latent image is now generally considered as divisible into two stages (1) The absorption of light by silver bromide and the immediate resulting mechanism, and (2) complicated chemical reactions between the product of the light action and the other substances, such as gelatin, present in the emulsion The first of these stages consists in the decomposition of silver bromide into silver and bromine and is known as the *primary process*, whilst the latter or *secondary process* is supposed to be concerned with the removal of the bromine (thus leaving metallic silver) due to its taking part in the chemical reactions which follow the primary process The problems arising in this secondary process appear only to be open to attack by chemical methods, but the first is susceptible to physical methods of attack

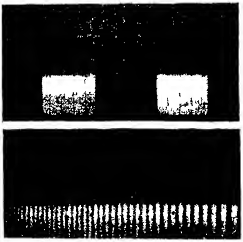
In the light of modern knowledge, the function of the light in decomposing silver bromide is to transfer the valency electron back from the bromine to the silver, *during its passage it is momentarily a free electron*

If, when light shines on silver bromide, there is no escape for the bromine set free (this condition holds when silver bromide is fused between quartz plates), then no permanent change in the substance can take place, and whatever exposure the salt may be given it will be in precisely the same state after the exposure as it was before But even if there is no actual decomposition, the mechanism of transfer of valency electrons still takes place when the silver bromide is exposed, only in this case there is an equilibrium existing between the rate of their liberation from the bromine ions and the rate at which they go back again It is these liberated valency electrons which cause the photo conductivity effect

Thus the photo conductivity effect in layers of silver bromide made under conditions such that the bromine cannot escape is simply an expression of the primary photographic process, isolated completely from all secondary chemical processes Since the primary process is the part chiefly concerned with the absorption of light, this explains completely why the spectral sensitivity of the photo conductivity effect in silver bromide is so similar to that of the finished silver bromide emulsion, as the previous communication showed

If these photo currents are simply due to the liberation of valency electrons, as in the photographic process, then, since we know that the latter can occur in an extremely short time, it is to be expected that these currents will start to flow almost instantaneously with the illumination of the silver bromide

If a melt of fused silver bromide containing electrodes connected in circuit with a source of E M F and a current measuring instrument be illuminated, very complicated effects will in general be observed, indeed, sometimes a strong *negative* effect (*i e* decrease of current on illumination) is the result The causes of these complications cannot be discussed here, but one of the chief difficulties, now overcome, has been to isolate the almost instantaneous electron liberation from all complications, such, for example,



A

B

FIG 1 —A Two exposures one of 0 46 sec and the other of 0 45 sec B A succession of exposures from 0 02 sec on the left to 0 06 sec on the right the dark vertical lines are 0 1 sec apart and the fine lines 0 01 sec apart

as those which occur at the electrodes The latter may be eliminated by using silver electrodes and shielding them from the light

A word of explanation is necessary in connexion with the accompanying photographs (Fig 1), the object of which is to show how nearly instantaneous is the photo current, due to liberated valency electrons, when isolated from all other effects A source of light was arranged so that a beam passed through a thin layer of silver bromide fused in between quartz plates and then fell on one half of a slit, behind which was a moving kinematograph film Electrodes in the solidified layer of bromide were connected to a valve amplifier which magnified the photo current about one hundred thousand times, and was connected to an Einthoven string galvanometer The image of the string was focused on the other half of the moving film, along which timing marks were produced at intervals of 0 01 second Thus the moment of illumination of the silver bromide was registered by the photographic impression on one half of the film (the lower half in the figures), whilst the time of appearance of the photo current as given by the galvanometer deflection could be read off from the other half

The film shows that the photo current starts within about 0 001 second of the illumination and is completely established within 0 03 second Since this is approximately the lag of the galvanometer in the

[1] Communication No 72 from the British Photographic Research Association Laboratories

valve circuit used, the probability is that the effect reaches its final value very much quicker than this, and there seems no reason to doubt that it *starts* instantaneously with the illumination as in the true photoelectric effect

Incidentally, the film is an illustration of a single beam of light producing *only* the primary part of the photographic process in one layer of silver bromide and the *whole* photographic process (primary + secondary, giving latent image) in another layer, *i e* in the emulsion on the film

We have further observed these photo currents with an intensity of ultra violet light which was so small that it only just produced a developable effect on a plate of H and D speed 550 in 1/25 second, *i e* the effect is observable in the region of normal photographic intensities

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Electron Reflection from Cobalt, and Electron Waves

MEASUREMENTS by a number of observers of the velocity distribution of the electrons leaving the surface of a metal under bombardment by a beam of electrons of known velocity, have shown that a part of the secondary electrons have the primary velocity, the rest having, in general, a lower velocity No attempt appears to have been made to resolve the secondary emission into its two components when the secondary emission is studied as a function of the velocity of the primary electrons This is a preliminary account of the results of such an experiment Previous work (Davis, *Proc Nat Acad Am*, **14**, p 460, 1928) has shown that the total secondary emission from cobalt, when plotted against the primary velocity, exhibits a number of sharp maxima and minima extending over an unusually large range of voltages This fact made it seem an ideal subject for the present type of investigation

The procedure was to measure the total secondary emission (including both groups of secondaries) and then to apply such a retarding potential that only those electrons having within a few volts of the energy of the primary electrons could reach the collector The difference between the two values so obtained for each primary velocity should give the magnitude of the group having the lower range of velocities The results of the experiment are shown in Fig 1 Here the ratio of secondary to primary currents as ordinates is plotted against the observed accelerating potentials Curve *A* shows the total secondary emission Curve *B* represents the 'reflected' electrons (those electrons leaving the target with velocities within two equivalent volts of the primary velocity), and curve *C*, the difference between corresponding ordinates of *A* and *B*, shows the behaviour of the low velocity group It appears that, for cobalt at least, the important maxima of the total secondary emission curve may be attributed to the 'reflected' electrons

The critical dependence of the number of 'reflected' electrons upon the primary velocity provokes speculation as to the nature of the phenomenon A number of unsuccessful attempts to connect the maxima in secondary emission curves with atomic characteristics having been made in the past, it seems possible that a more fruitful line of reasoning might be one analogous to that used so successfully by Davisson and Germer (*Phys Rev*, **30**, **705**, **1928**) in explaining the reflection of electrons at the face of a single crystal of nickel The observations being reported on were made with a polycrystalline cobalt target rather than a single crystal Hence electrons might be expected to suffer diffraction at its surface in a manner similar to the diffraction of X rays in the so called 'powder' method In this case the Bragg formula

$$n\lambda = 2d \cos \theta$$

should be satisfied, where n is the order of the diffraction beam, λ the de Broglie wave length

$$\left[\lambda = \frac{h}{mv} = \left(\frac{150}{V}\right)^{\frac{1}{2}}\right]$$

of the electrons, d the spacing of the diffracting planes, 2θ the angle between incident and diffracted beam, and V the velocity of the incident electrons in equivalent volts

The longest wave length which can be diffracted by a set of planes with a spacing d will be $\lambda_{max.} = 2d$ From the geometry of the apparatus it follows that,

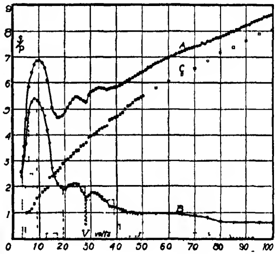

FIG 1

in order to reach the receiver, secondary electrons must leave the target at an angle with the normal not greater than 60° Applying the Bragg formula within this angular range to the most important sets of planes known for cobalt in the hexagonal close packed form, it is possible to compute ranges of electron velocities, or bands on the wave length scale, which should be sent back into the receiving cylinder by constructive reflection These bands are shown in the figure, their relative intensity having been taken as the known relative intensities of the corresponding X ray reflections

It will be seen that by this simple and obviously only approximate procedure, a fair correspondence is obtained between three groups of bands and the most prominent maxima of the secondary electron curve The degree of correspondence shown was obtained by shifting the observed curve to the right by a matter of 4 to 5 volts, which is just about the observed thermionic work function of cobalt It should be pointed out that such a small shift is not in agreement with Davisson and Germer's adjustment of their own observations, they having found that an assumed surface potential of about 18 volts was the most satisfactory

Bethe has derived approximately the same large value from theoretical considerations In spite of this difference, it seems worth while directing attention

to what can be done in the way of accounting for secondary electron maxima of cobalt on the basis of electron waves Attempts to correlate, in a similar way, the maxima observed with other metals are now being made

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Temperatures of Positive Ions in a Uniformly Ionised Gas

A GAS through which a current is passing may be considered as a mixture of three gases—neutral molecules, electrons, and positive ions In regions of relatively small field and space charge, each of these gases will show an approximate Maxwellian distribution of energies among the particles, that is, will be in temperature equilibrium within itself, but each gas will have a different temperature Even at gas pressures so high as a millimetre of mercury, and in an almost field free space, the temperature of the positive ions will be very much higher than the temperature of the neutral molecules with which they are continually colliding The only available source of energy of random motion appears to be the electron gas, which is at a still higher temperature L H Thomas (*Proc Royal Soc*, A, **121**, 464, 1928) derives formulæ for the interchange of energy between particles interacting according to the inverse square law and uses them to explain the rapidity with which a Maxwellian distribution of velocities is set up within an electron gas They may also be used to calculate the temperature of the positive ions from the temperature of electrons and the pressure of the gas in a field free space

For comparison with the calculations, data of mine on the width of lines emitted from the negative glow of the helium arc will be used (*Phys Rev*, **32**, 918, 1928) The following assumptions form the basis of the calculations

1 The positive ions acquire energy solely from the energy of random motion of the electrons

2 They lose energy by collision with the molecules of neutral helium at a rate which may be calculated from kinetic theory

The rate at which the positive ions acquire energy from the electrons is calculated from formulæ (4 22) and (4 23) of Thomas's paper, assuming all the electrons to have the most probable velocity and neglecting the velocity of the positive ions In calculating the loss of energy to the neutral molecules, the latter are taken as stationary and the radius of the ion is taken from the Bohr theory of the helium ion Equating the rate of gain to the rate of loss gives the calculated temperature As the pressures were very roughly measured and the ion temperatures are subject to considerable uncertainty, the data do not warrant making a more exact calculation The comparison is given in Table I

TABLE I

Electron Temp (Volts)	Electron Density (Electrons/c c)	Gas Pressure (mm of Mercury)	Ion Temp Calc (Volts)	Ion Temp Obs (Volts)
0 66	$3\ 2 \times 10^{12}$	1 1	0 12	0 07
0 52	$7\ 5 \times 10^{11}$	0 5	0·11	0 10
1 2	$2\ 1 \times 10^{12}$	0 4	0 14	0 14
0 87	$3\ 4 \times 10^{12}$	0 4	0 22	0 10
0 86	$1\ 8 \times 10^{12}$	0 25	0·20	0 14

That the calculated values are consistently high may be due to neglecting the shielding effect of the gas on the interaction of the charged particles or to taking too small a radius for the helium ion The agreement is within the error of calculation and measurement It is interesting that even the order of magnitude is correct, as all direct measurements of interaction between positive ions and gas molecules give values which differ from those calculated from the kinetic theory Harnwell (*Phys Rev*, **31**, 634, 1928), for example, found that the loss of energy of alkali ions of high velocities passing through helium was only a few per cent of that expected Ramsauer and Beeck (*Ann der Physik*, **87**, 1, 1928) made measurements on the same ions which extended to velocities so low as one volt, and found that the effective radii of interaction were always larger than the predicted radii and increased rapidly as the velocity decreased The radius of the helium ion is so small compared to the radius of the helium atom that doubling or tripling it would have only a small effect on the calculated temperatures of Table I Interesting results of the calculation are that the ion temperature should increase with decreasing electron temperature and increase with increasing electron concentration The range of variation of electron density and temperature in these experiments is too small to test these conclusions

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Selenium and Cathode Rays

IN the course of some experiments upon the light sensitive properties of selenium, evidence has been obtained by me of what appears to be a direct action of cathode rays upon the grey crystalline form of that substance

The cell was prepared by condensing vapour of heated selenium upon a gold grid It was placed in a glass tube which could be exhausted and so arranged that a pencil of cathode rays fell upon the crystals after passing through the openings in an earth-connected metal gauze tube which completely surrounded the cell The cell itself was also connected to earth

Precautions were taken to absorb all mercury vapour that might otherwise have diffused from the pump into the exhausted vessel and provision was also made for the elimination of moisture

A simple plan was devised to detect the effect, if any, of the slight luminosity due to fluorescence that appeared when the discharge occurred, and a series of control experiments were made with all conditions similar except that a plain gold grid *without selenium* was placed within the earthed gauze screen

The anode was sealed into a side tube behind the cathode and at a distance of about one inch from it

It was found that, although the selenium cell used was markedly sensitive to light, no appreciable effect whatever was produced by the slight luminosity of the tube due to fluorescence either of the walls or of the glass strip upon which the selenium was deposited

When the cell was exposed to cathode rays, however, a rapid diminution of resistance occurred which could be widely varied by deviating the rays with a magnet

The cell exhibited many of the effects observed when light was shone upon it but the lag was less Its resistance somewhat increased at first, due to the bombardment, so that the 'dark current' was reduced This effect was not permanent, but

frequently resulted in an unusual rise of the 'dark current' value after the discharge had ceased

It is improbable that the marked action of the cathode rays can be attributable to the production of X rays in the selenium, because in that case the decrease of resistance and recovery would have been far less and taken place much more slowly

Experiments made by enclosing the cell in an earth connected brass tube provided with an aluminium window 3/1000 inch thick looking towards the cathode, but through which the cathode rays could not penetrate, produced a very slight and gradual decrease of resistance, this and the slow increase on cessation of the discharge are typical of the action of X rays upon selenium In this case the X rays were generated at the aluminium window

Under these conditions, and with a P D of 60 volts across the cell, the reading of the microammeter rose slowly 10 microamperes, whereas on replacing the aluminium window by one of metal gauze the deflection suddenly increased to 250 microamperes and fell rapidly, with a slight lag, before returning to the 'dark current' value, when the cathode rays were momentarily allowed to impinge upon the selenium The alternate spark gap at the induction coil was two inches, and the only luminosity appearing in the tube was that due to fluorescence

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Deposition and Surface Tension

THE publication of a lengthy study of related phenomena by L K Luce (*Ann de Phys*, February 1929, pp 167 257) prompted this preliminary report of similar results found by the same as well as other methods during the last two years, under the direction of Prof Gerlach, in Tübingen

Iodine deposits resulting from directional molecular rays, as in the Dunoyer experiments (*C R*, **152**, 592 594, 1911), showed that those of a homogeneous nature are only possible on smooth, clean, perfectly annealed surfaces On a surface, which was etched, rubbed, or scratched in any particular portion, crystal nuclei started growing immediately A long series of experiments on glass and silver surfaces of various convex and concave curvatures, showed that deposition and chemical attack are a function of the curvature, cold working, or, in short, a function of the surface tension of the underlying surface Reboul's early work (*C R*, **155**, p 1227, 1912, and **156**, p 1376, 1913) on the chemical attack of silver rods of different curvatures, as well as Luce's later work, give functional curves which are not unlike those obtained in Tübingen

That the factors of adsorption and diffusion play a part in these experiments, as Luce remarks in his work, we find very probable Adsorption experiments on glass surfaces of known curvature carried out on a long series of glass tubing, and on plane glass of different varieties, show similar functional relations to the results for deposition and reaction Such thin layers can be weighed with a microbalance For plane and slightly curved surfaces the sorption layer does not exceed monomolecular thickness, which agrees with the theory of Langmuir (*Zt f Elektrochemie*, **26**, p 197, 1920), but with increasing curvature the adsorbed layer increases In capillaries 0 8 mm in diameter and less, the adsorbed layer is of the order of seven molecules in thickness Where chemical attack plays the primary rôle, diffusion is of greater importance Experiments on single crystals of silver are being carried on, and it is hoped that they will throw light on the nature of diffusion

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Invisible Oxide Films on Metals

IN his letter in NATURE of April 13, page 569, Dr F H Constable adduces interesting evidence bearing upon the formation of invisible oxide films on copper at room temperatures In fairness to Dr W H J Vernon, whose researches in this field are not mentioned by Dr Constable, it should be stated that, working in my laboratories under the auspices of the British Non Ferrous Metals Research Association, he demonstrated the formation of invisible oxide films on copper, and studied their inhibiting effect on tarnishing

Dr Vernon's results were communicated to the Atmospheric Corrosion Research Committee in 1923 though they were not published until three years later (*Journal of the Chemical Society*, p 2273, 1926) Invisible protective films were obtained by exposure to air at room temperatures, while at higher temperatures (from 50° C upwards) certain quantitative relationships were established A critical thickness of film was recognised, *within the invisible range*, below which protection was no longer afforded, it was concluded that this corresponded with the unit lattice of cuprous oxide Later (*Transactions of the Faraday Society*, **23**, 113, 1927) it was shown by the same worker that under favourable conditions, invisible protective oxide films are also produced at room temperatures upon lead and iron

It is interesting to note that some of Dr Vernon's earlier conclusions are confirmed by the spectrophotometric methods employed by Dr Constable Moreover, it is satisfactory that there is now general agreement as to the part played by the direct oxidation of metals at ordinary temperatures, about which only a few years ago differences of opinion existed

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Skull Thickness

WITH reference to Mr Wilfred Trotter's paper, published in NATURE of April 6, the following quotations from Herodotus (Isaac Taylor's translation) may be of interest

"A remarkable Fact was pointed out to me by the People who live on the Spot where this Battle took Place The bones of the slain being heaped apart—the Persians lying by themselves as they fell in their Ranks, and the Egyptians separately also,—the skulls of the Persians are so weak, that you may, if you please, break them in, by throwing a Pebble, while those of the Egyptians are so strong, that you scarcely produce a Fracture by dashing a stone at them"—"I observed also a similar appearance on the Field at Papremis, where lay those slain by Inarus, the Lybian, under Achaemenes, son of Darius."

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The Volta Temple at Como

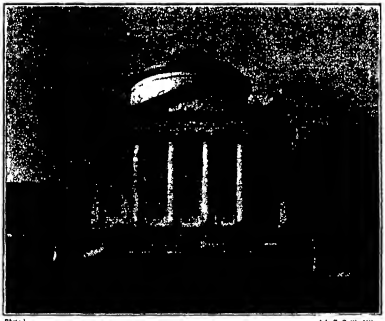
IN the year 1899 the centenary of the discovery of the voltaic pile was celebrated in Como, Volta's native city, by a joint International Electrical Exhibition and a National Exhibition of Silk Products On the morning of July 8, fire broke out in the Exhibition, and the buildings and their contents, including the precious collection of Volta relics, were almost entirely destroyed within the short space of forty minutes

Of the instruments constructed and used by Volta in his epoch making experiments, only a few damaged fragments were recovered By a fortunate chance, Volta's documents were not being exhibited, as the Royal Institute of Lombardy had refused to allow them to be sent to Como The rebuilding of the Exhibition was commenced immediately, and was prosecuted with such vigour that the reopening ceremony took place on Sept 1, less than two months after the fire

A few years later the more difficult problem of the restoration of the Volta relics was attacked energetically and, in view of the apparent futility of the attempt, secretly, by one of Como's citizens, Francesco Somaini, with the help of a small band of earnest coadjutors, and in due course was successfully accomplished No pains were spared and no document or drawing bearing on the subject was left unstudied, so that the resemblance of the reproductions to the original instruments is as close as it is humanly possible to make it Besides having this work done and bearing the cost thereof, Somaini has, also at his own expense, erected the sumptuous Volta Temple, in which the whole of the relics, including Volta's records, the national edition of Volta's works, etc, are now housed

This temple was designed by Frigerio, and is situated close to the shore of the lake It is of incombustible material throughout, and is in the neoclassic style, consisting essentially of a circular court or hall of ceremonies, surmounted by a hemispherical cupola which admits a soft light to the interior On the roof of the building, at each of the four corners, is a pedestal light faced by a griffin The main floor of the temple is approached by two wide lateral staircases, and the doorway has, on either side, recessed statues representing Faith and Science

Within, the recesses between the central court and the outer walls of the building contain glazed cases in which are arranged both the fragmentary remains of the instruments rescued from the fire and the reproductions of the originals The court contains a bust of Volta on a tall column and an ornamental bronze tripod presented by the University of Pavia, where Volta served for several decades as professor and rector



Photo] [A G Gatti Milan
FIG 1 —The Volta Temple, Como

A marble staircase, to the left of the entrance, leads to a gallery which surrounds the central hall and contains the library, manuscripts (including some which Somaini was fortunate enough to discover at Vienna), medals, minor records, etc The cupola is supported by four decorated angular pilasters and eight marble columns On the front of the parapet of the gallery are sixteen plaques giving the most significant dates in Volta's life, and four bas reliefs representing him teaching at the University of Pavia, demonstrating his pile to Bonaparte at Paris, receiving the Emperor Napoleon in Pavia, and prophesying, as he leaves the church at Lazzate, telephonic communication The mosaic paving of the circular hall and of the surrounding recesses is ornamented with marble, onyx, and alabaster, and the framework of the glazed cases in which the exhibits are arranged is of iron or bronze coated with green patina so as to resemble ancient bronzes

The skeleton of the building, including the foundations, is of reinforced concrete, the external ornamentation being chiefly of Aurisina stone and the internal of Musso marble, Viggiù stone, and stucco The structure measures about 20 metres wide by 25 deep, and the height to the apex of the cupola is more than 21 metres The building was commenced in November 1925 and was completed by May 1927

First among the instruments invented by Volta comes the electrophorus (1775), which followed as a natural consequence of the views expressed in his dissertation "De vi attractiva ignis electrici ac phenomenis independentibus," published in 1769 In the three years subsequent to the appearance of the electrophorus, Volta studied, both theoretically and experimentally, the influence of the form on the electrical capacity of a conductor and elaborated the conception of tension or electrical potential These considerations formed the starting point of a thorough investigation into the action of atmospheric electricity, this leading to the invention of the condenser, which is also numbered among the exhibits While developing his ideas concerning electric meteorology and the origin of atmospheric electricity, Volta devised the very sensitive straw micro-electrometers and the electrostatic balance, reproductions of these being among the apparatus shown The various forms of voltaic pile assembled by the inventor from such ordinary household articles as spoons, and water-vessels from bird-cages, are also included

Photo] FIG 2—Interior of the Volta Temple [A C Gatti, Milan

The temple has been placed in the charge of Prof Felice Scolari, in conjunction with the Royal Lombardy Institute, and has been generously provided, also by Somaini, with an endowment fund of 500,000 lire, the income from which is to furnish annual prizes of 5000 lire each, to be awarded to distinguished students of Como or of the canton of Ticino desirous of prosecuting studies in electrical subjects

Physics in Relation to Oil Finding[1]

By Prof A O Rankine

EVIDENCE has accumulated during recent years that physical methods can be used under suitable conditions to facilitate the detection and location of minerals buried under the ground This is a fact of considerable economic importance, having regard to the very great and wasteful expense of indiscriminate boring Even the most careful geological survey often fails to fix with sufficient accuracy the points at which drilling is likely to be successful Here, properly applied, physics may make its contribution to enhance the probability of success

We are not now concerned with the divining rod and similar devices—similar, at any rate, in the respect that they can only be operated by persons specially endowed with certain obscure faculties Sometimes the devices are dressed up to have the appearance of physical apparatus, and the methods are called geophysical, but all have this in common —that they are not capable of being independently checked, and for that reason may safely be ruled out of serious consideration We are dealing with genuine physical methods which depend on the differences of physical properties of underground materials, and produce above the surface reliable indications, the measurement of which may provide valuable information regarding sub-surface structure

It is important to emphasise at the outset that there is no question of physics being employed to the exclusion of geology At the best the problems to be solved are extremely difficult, and the closest possible co operation between the two sciences is essential This alliance is implied in the term 'geophysics,' and for the successful development of this as a practical subject, geophysicists adequately trained both in physics and geology are the ideal personnel Physics alone cannot solve problems of underground structure, whatever may be the efficiency of the method employed, for the unknown factors are far too numerous for a unique solution to be possible The geologist must first indicate the kind of underground structure which is sought, and all the probable conditions under the region to be surveyed, before the physicist can even decide whether any available physical method

[1] Substance of two lectures delivered at the Royal Institution on Feb 21 and 28

has a reasonable chance of being applied with success. Often, owing either to the absence of surface indications of a geological character, or to such indications being misleading because of 'non conformability' of superincumbent strata, the geologist is unable to locate with precision the structures he is seeking. It is in such circumstances that physics has been able to join forces and help to define underground conditions more exactly.

With particular reference to the occurrence of mineral oil, geology provides the information that it is usually associated with salt-domes or anticlines, buried more or less deeply below the earth's surface. A typical salt dome, of which there are numerous examples in Texas, is a sort of underground plateau of rock salt, sometimes with a relatively thin covering of anhydrite, called cap rock, the whole being below an overburden of sands and clays. The superficial area of the roughly circular top of the dome may be several square miles, and its depth may vary from a few hundred to several thousand feet. Oil may be located sometimes at the top of the dome, and sometimes at various levels down its flanks. The earth's surface above and around the dome is usually very flat, and there is little in the way of reliable geological indications to determine their positions.

On the other hand, limestone anticlines, such as occur in south-west Persia, are blunt limestone ridges, perhaps several miles in length and relatively narrow, covered, too, with a thin layer of cap rock, underlying a mixture of alluvium, sand stones, marls, gypsum, and salt. In the upper part of the anticline, just below the cap rock, natural gas may be found; farther down the flanks occurs the crude oil with much gas in solution, and still farther down the flanks salt water. Unlike the conditions relating to salt-domes, however, surface evidence of folding structure is abundant, the general direction of the strike being unmistakable. But, unfortunately, owing apparently to the plasticity of the overburden, these geological indications leave in considerable uncertainty the positions of the summits of the anticlines.

Here, then, is the problem of oil finding from the point of view of physics. It is to locate, within regions already roughly delimited by geological considerations, the position and extent of salt domes and limestone anticlines. Thus the search is not for the oil itself, but for the structures with which it is commonly associated. It is true that some claims have been made of locating oil as such by a method depending on its electrical conductivity, but this is very doubtful, and on theoretical grounds the method is distinctly unpromising. To find the oil itself is not asked of the geophysicist; if he can locate the salt dome or the anticline with enough precision, it will always be worth while to drill.

The physicist thus has to consider what properties of these structures are likely to provide surface indications capable of physical measurement and interpretation. Caution is necessary in this respect, having regard to the unfortunate tendency to generalise geophysical methods. These have been enumerated in Prof Eve's interesting article in NATURE last year.[2] Although various claims have been made, there exists no convincing evidence that magnetic and electrical surveys have assisted materially in the location of the structures under discussion. Moreover, the magnetic susceptibilities and electrical conductivities of salt and limestone differ insufficiently from those of the surrounding materials to give on theoretical grounds any real expectation of successful application. The only physical properties which have hitherto without doubt provided means of discrimination are the differences of density and elasticity as between the salt or limestone on one hand, and the superincumbent material on the other.

Remarkable success has been achieved by measuring local variations of gravity which depend directly on the differences of density of sub surface materials. The approximate relative densities of salt and clay, for example, are 2.1 and 2.4, and of the cap-rock over a salt dome 2.9. Small though these differences are, the elegant and amazingly sensitive Eötvös torsion balance has been proved capable of measuring the corresponding gravitational effects in the neighbourhood of numerous salt domes in Texas and elsewhere, thereby locating and defining the limits of such domes, some of them deeply buried below the surface. For a lucid account of this beautiful instrument the reader may be referred to papers by Capt Shaw and Mr Lancaster Jones.[3]

The main purpose of this article is to give an account of a relatively new and less well known successful method of locating structures likely to be oil bearing, known as the seismic method. This method can be applied even in rough country, like that in the Persian oil fields, where gravity measurements are too much distorted by surface effects to give reliable indications of underground conditions. It depends not only on the relative densities but also on the relative elasticities of the rocks encountered, or, what amounts to the same thing, the speeds of propagation of longitudinal mechanical disturbances in these media. In the salt dome structures of Texas, these velocities differ considerably, being about 5300 metres per second for the salt, and about 2000 metres per second for the clay and sand overlying the dome. For the limestone structures of Persia the difference is not so marked, the approximate figures being 4700 metres per second in the limestone and 3700 metres per second in the overburden.

One may perhaps digress for a moment to consider the possibility of using direct reflection from a clay salt interface as a means of determining its depth. If a device similar to the remarkable depth sounding machine[4] which has been so successful at sea could be used, the great advantage would accrue that the measurement of the time taken for the sound to go down to the interface and return by normal reflection would enable the local depth to be estimated. But the method is not

[2] 'Geophysical Prospecting.' By Prof A. S. Eve, NATURE, Mar 10, 1928, vol. 121, p. 359.

[3] *Proc Phys Soc*, vol. 35, p. 151 and p. 204.

[4] "The Acoustic Method of Depth Sounding for Navigational Purposes," by the Staff of the Director of Scientific Research, Admiralty, NATURE, Mar 29, 1924, vol. 113, p. 463.

successful in practice, not because of the failure of the interface to reflect, the reflecting power being reasonably great, but because of the enormous damping of vibrations of audible frequency in the upper layers of the earth Trials with an Admiralty echo sounding machine have actually been made in Persia, but the sounds from the hammer proved much too feeble to be heard through the ground on the microphone at any useful distance It is significant also of the poor transmitting power of the ground that the explosion of several hundred pounds of gelignite at half a mile distance was not audible through it as a medium, although it could be heard, of course, very loudly through the air

We are thus faced with the position that great disturbances of the earth's surface, conveniently in the nature of explosions, are necessary effectively to penetrate to the depths at which oil bearing structures are frequently found Also that a seismograph, which will record vibrations of low inaudible frequency, is preferable to the microphone on account of the smaller damping of such vibrations This at once rules out the direct determination of depth, previously suggested, for a sensitive seismograph obviously cannot be operated in the same position as a large explosion which excites the initial disturbance The recording must be done at a 'safe' distance and the depths of the interface at points other than those immediately below the explosion become involved, thus complicating the problem by the change from one to two dimensions

The necessity for using an explosion involves a new difficulty on account of the appreciable time the consequent disturbance of the earth lasts In all cases the reflected disturbance reaches the seismograph *later* than that travelling direct near the surface, since its path is longer Moreover, it is usually small in comparison with the direct waves, and the effects of the latter upon the seismograph at practicable distances last considerably longer than the difference of times of transmission Consequently the reflected effect becomes so much obscured by the larger direct effect as to be unrecognisable The solution to this difficulty lies in the existence in practice of another disturbance associated with the lower (higher velocity) medium, but distinct from the reflected disturbance, which may, at a sufficient distance from the explosion, reach the seismograph *first* Although small, its time of arrival can be readily recognised, since it makes its record on the seismograph *before* the latter becomes violently disturbed by the direct waves That is the essence of the success of the seismic method of revealing underground structure

The phenomenon with which we are dealing is the same as that which has recently been recognised as operative in natural earthquakes Even in near earthquakes, where the curvature of the earth plays no important part, the records of seismographs show preliminary displacements which apparently correspond to 'rays' from the earthquake source which pass from an upper stratum (of low propagation velocity) at the critical angle into a lower stratum (of higher propagation velocity), run parallel to the interface and eventually emerge again at the critical angle to reach the seismograph on the surface This is, of course, an 'optical path' of an extreme character according to the ordinary laws of refraction, but since the initial incidence is at the critical angle, total reflection would occur according to the same laws, and no energy at all would be associated with the path in question Dr Jeffreys[5] has, however, shown that if the problem be treated as one of diffraction instead of simple refraction, the rather curious result emerges that a finite fraction of the initial energy may be expected to reach the seismograph (as is in fact found in practice) at a time which is the same as that obtained by considering the extreme optical path above described This applies to longitudinal disturbances There are in solids, of course, transverse disturbances as well, but these travel more slowly, and need not concern us here, since, as has been already stressed, the question is one of *first* arrivals

Prof Mintrop was the first to recognise the applicability of this phenomenon to the smaller scale problem of the relatively shallow formations in the earth, using artificial explosions instead of natural earthquakes As a result he has initiated a practical system which has been widely and successfully used to determine the depths of such formations To make the method clear, we may take the simple case of two superposed horizontal strata (Fig 1) in which the velocities of com-

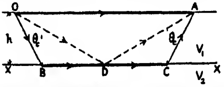


FIG 1 —Explosion at O seismograph at A both on the earth's surface XX is interface between two media of velocities V_1 and V_2 with $V_2 > V_1$

pressional waves are V_1 and V_2 the latter corresponding to the lower medium and being (necessarily) greater than V_1 If an explosion is caused at O and a recording seismograph is located at A, three distinct disturbances reach the seismograph One goes direct from O to A (We are neglecting here the small curvatures which may arise from gradual variation of velocity with depth) Another is reflected at D and arrives at A necessarily later than the former, its path being longer The remaining disturbance arrives at A at a time corresponding to the equivalent path $OBCA$, OB and AC each making the critical angle $\theta_c = \sin^{-1} V_1/V_2$ with the normal In the part BC the speed is the higher velocity V_2, and it is evident that if OA is great enough the total time occupied in transmission may be equal to or even less than that for the direct path OA, which is wholly in the lower velocity medium If so, its small effect will be recognisable on the seismogram in spite of the large disturbance which follows afterwards

(*To be continued*)

[5] On Compressional Waves in Two Superposed Layers By Dr H Jeffreys, *Proc. Camb Phil. Soc*, vol 23, p 472, 1926

Centenary of the Zoological Society of London

THE annual gathering of the Zoological Society of London to receive the Council's report was held on Monday last, April 29, at the meeting room in the Gardens at Regent's Park The occasion signalised the centenary of establishment of the Society by Royal Charter in 1829 Following this compliance with precedent and duty, a centenary celebration, extended and exceptional in character, took place in the Great Hall of University College, the Duke of Bedford, the Society's president, occupying the chair In the evening a private complimentary dinner was held elsewhere, at which foreign and official guests were present, including the Prince of Wales

The Zoological Society itself, as an organised body carrying diverse and onerous responsibilities, has deserved well in endeavour during its centenarian existence, its gardens, moreover, as a prime and essential feature of the original scheme, have long constituted a household word inseparable from national thought and concern But the story of initiation of effort is somewhat older than the century implied by the charter date, 1829, and is comparable, we think, with the early beginnings of other scientific societies which sprang up at the threshold of the Victorian era There were influences tending towards corporate association, such as British exploratory activity, the arrival of natural history specimens, and new views attaching to zoological studies The Linnean Society, instituted in 1788, could not, as time went on, fully satisfy the requirements of zoology In such circumstances, a group of members of that body conceived the idea, in 1822, of establishing a Zoological Club, the object of which should be "the study of zoology and comparative anatomy in all their branches, and more especially as they relate to the animals indigenous to Great Britain and Ireland" The meetings were held in Soho Square, at the former residence of Sir Joseph Banks (who had died in 1820) and home of the Linnean Society

The Club accomplished much important work before its dissolution in 1829 Engaged in the advancement and recognition of zoology, the members were mutually cognisant of the outstanding achievements of Sir Stamford Raffles, the distinguished British colonial governor in Eastern lands, and of the unique and extensive zoological collections he had brought together On returning permanently to England in 1824, Sir Stamford suggested to Sir Humphry Davy, the president of the Royal Society, a plan for the formation of a zoological society which should combine with the pursuit of science the introduction and domestication of such quadrupeds, birds, and fishes as might be most likely to prove useful for agricultural and domestic purposes

Early in 1825 a circular announcement was made of a proposal to establish a society the object of which would be to attempt the introduction of new races of quadrupeds, birds, or fishes, applicable to purposes of utility, either "in our farm yards, gardens, woods, waters, lakes, or rivers, and to connect with this object a general zoological collection of prepared specimens" The name of Sir Stamford Raffles occurs in this circular, as well as, it is interesting to note, that of the Duke of Bedford Writing round about this date to his cousin, Sir Stamford says "I am much interested at present in establishing a grand zoological collection in the metropolis Sir Humphry Davy and myself are the projectors, and while he looks more to the practical and immediate utility to the country gentlemen, my attention is more directed to the scientific department, it is further expected we may go far beyond the Jardin des Plantes at Paris" Here, adverting again to the members of the Zoological Club it was afterwards (1829) put on record that it was in the impulse originally given by their exertions to the propagation of science more particularly by laying the foundation of the Zoological Society, that their agency could be traced in principles and objects

The scheme outlined briefly above, wide in its interests, and to be regulated by laws drawn up with the concurrence of the members, met with a cordial reception, and by this time (1826) Sir Stamford Raffles was an active, and in all probability dominant, personality in the difficult procedure of inauguration Wisely, the decision was taken to draft a report on the present state and progress of natural history, especially zoology, with an account of the institutions which supplied encouragement on the Continent, and showing the necessity of some similar establishment in Great Britain Next, application was made to the Commissioners of Woods and Forests for a grant of land from the Crown Looking back, we may perhaps picture some perturbation of the official mind respecting so novel a proposition However, all went well, and finally space was allotted in the great demesne of Regent's Park

The first general meeting of the Society was held on April 29, 1826, when Sir Stamford Raffles was unanimously elected president He read an introductory address reviewing the position of zoological studies, detailing also the objects and plans of the embryo institution Soon after, there occurred, on July 5, the death from apoplexy, at the early age of forty five, of this notable president and man of affairs Sir Humphry Davy, in offering tribute, said of him that 'having lost one splendid collection by fire he instantly commenced the formation of another, and having brought this to Europe, he made it not private, but public property, and placed it entirely at the disposal of a new association for the promotion of zoology, of which he had been chosen president by acclamation" The following year the Marquess of Lansdowne was elected to the presidential chair, retiring in 1831 The fellowship roll comprised then 2000 names In 1829 the crowning of effort came in the grant of a charter by King George IV

Through limitations of space we must leave at

this point reference to the activities of the immediately succeeding years as regards both the Gardens and the Society Some idea, however, of the achievements which had marked the close of the nineteenth century can be formed by a perusal of Mr H Sherren's interesting volume on the Zoological Society

The establishment enjoyed special advantages during the secretaryship of Dr P L Sclater, covering forty three years Since then the zealous and enterprising work of Dr P Chalmers Mitchell has brought the Society to its present distinctive and high position among the zoological societies of the world As regards staff, it is significant that two women now hold office, respectively, as curator of reptiles and curator of insects Recently, the Society has acquired Whipsnade Park, on the borders of the Chilterns, a derelict estate, destined for conversion into a zoological park, open to visitors

News and Views

BRITISH chemical manufacture since 1913 has not only made rapid strides which have brought it into a position of commercial eminence and have kept it abreast of world wide development, but it has also, at least so far as its leaders are concerned, taken care to consolidate the ground gained and to prepare for further progress by the establishment and endowment of research work At a public meeting arranged by the British Science Guild at the Mansion House on April 24, an account of which appears elsewhere in this issue, Lord Melchett, Sir Frederick Keeble, Mr A B Shearer, and Mr F H Carr showed something of the immensity of the contribution which chemical manufacture is making, especially in Great Britain, to the welfare and prosperity of the people The attention of the recipients is of course distracted at the moment by discussions and political promises of employment, industrial prosperity, peace, and social service Perhaps it was fortuitous, but more probably inevitable, that the very same phrases were used, not of ideals, but of solid accomplishments, by the speakers The artificial silk industry has already, directly or indirectly, given employment to hundreds of thousands of workers, creating its own demand, it has often brought a touch of colour and beauty where there was little that was not drab and formless, and it has probably not been without influence where of late years a notable increase in self respect and self confidence has been apparent The nitrogen industry, in time of war a sharp sword for which the British Empire reached too late, has since been beaten into a ploughshare, which is already firmly harnessed to man's ever increasing material needs, so that the fear of nitrogen hunger has been completely dissolved The drug industry has already been enabled in a multitude of homes to give health where but the spark of life remained, to free the mind from the assaults of the body, and to raise barriers between whole communities and the menace of disease

ALL this has been made possible by basing commercial acumen and technical skill on a firm foundation of fundamental research The chemical industry is a structure which must be designed elastically, in order that it may rest securely and continue to grow on a base which is not only continually extending, but also may at times be found deceptive in its appearance, as researchers probe more and more deeply into the origin and meaning of things It is to the credit of British industry and to that of the State that provision has been made for such investigations to be carried on both in the industrial and in more purely academic laboratories Scientific research of many kinds is even more than a base, it is a frame whereby existing industries are kept virile and progressive, and around which may be built a new industry We cannot enter into a discussion regarding the precise relation of our chemical industries to the various articles of political faith, but we can at least point out three ways in which individual or political action can help to maintain our industry and pave the way for further successful advances We hope that our fellow citizens will never permit themselves to forget the vital position which modern chemical manufacture occupies, not only in determining the prosperity of nations, but also in alleviating human suffering and in increasing the comforts of life Further, we hope that they will use their influence, in whatever way seems to them proper and effective, to secure that those industries shall be nurtured in their infancy, fed with men and women of sound training, and encouraged in their growth Finally, although we should not contemplate with equanimity an entire Cabinet of chemists, we hope that the experience and advice of our pioneers in science and the scientific foundation of industry may be given yet greater weight in the counsels of the nation

A LARGE and representative assembly attended the centenary celebration of the Zoological Society, held on Monday last in the Great Hall of University College, London The Duke of Bedford, president of the Society, occupied the chair, supported by members of Council and those who were designated to convey congratulations on behalf of British and foreign countries In his introductory remarks the president extended grateful thanks to the delegates who had come from many parts of the world to offer good wishes in person, and express their appreciation of the Society's long continuity of effort Dr P Chalmers Mitchell, secretary, gave an epitome of the scientific work which had engaged the attention of the Society He emphasised that the institution was founded by scientific men, and that their aim was not to be merely exhibitors of animals and entertainers of the public The Society has an obligation to advance zoological studies and is fully mindful of it In parasitology much has been done of practical importance to men and animals An interesting summary was given by Dr Mitchell of the work of the prosector's department. Through the publications of the Society a great body

of original research is carried on and encouraged, and he recalled that one of the obligations is the maintenance of a standard library In physiology, the relations of animals to their environment, or response to different physiological conditions, is receiving attention in the light of modern studies in that field

Sir Charles Sherrington offered felicitations on behalf of the Royal Society, M Charles Gravier, for the Paris Academy of Sciences, Zoological Society of France, and the Paris Museum of Natural History, Herr H H Dieckhoff (representing the German Ambassador), speaking in excellently phrased English, claimed that Germany has always been happy to assist in the Society's pioneer work, which has brought rich compensations to knowledge Dr Casey Wood, speaking for the Smithsonian Institution, Washington, referred to a message just to hand from its secretary, Dr C G Abbott, who, he thought, represented the natural history institutions of his country The message ran "It is my desire to extend to you the greetings and best wishes of our organisation overseas The Smithsonian Institution has had close and pleasant affiliation with the Zoological Society of London It is my sincere wish that your Society may grow and prosper equally in the coming hundred years as it has in the century that has elapsed" Dr Jordan, Royal Academy of Sciences, Amsterdam, expressed "deep and proud respect" Prof Cossar Ewart and Prof A F Dixon, representing respectively Scottish and Irish institutions, offered congratulations The proceedings, which were worthy of the great Society, closed with a vote of thanks to the Duke of Bedford, proposed by Sir John Bland Sutton

An instructive discussion took place in the House of Lords on April 25 on the proposed large power station in Battersea The principal objection to this station is the probable large emission of sulphurous fumes from the proposed chimneys, which will be 255 feet high It appears that approximately one third of the station will replace three existing generating stations, and to this extent only has authorisation to proceed been given at present The displaced stations are antiquated, and it has been calculated that the completion of this part of the scheme will reduce the present output of sulphurous acid by about 30 per cent We understand that the matter is being carefully considered by the Ministry of Health Unless the Ministry, the Government Chemist and the Department of Scientific and Industrial Research, say that no danger accrues from this cause, the full scheme is not to be completed Special methods are being tried for cleaning coal so as to reduce its sulphur content Washing the chimney gases with forced sprays of water is also being tried For large scale research, one of the large London power stations might be employed Lord Birkenhead pointed out that little had been done in the past to develop the cheap supply of electric power, on which our future commercial prosperity largely depends He said that the arguments brought forward by the opponents of the scheme should have been brought forward two years ago, and that the erection of the new power station would, from the commercial point of view, be a great boon to the residents in Battersea In our opinion, intensive scientific study should be devoted to the elimination of sulphurous acid from the chimney gases, and electrical engineers would do well to enlist the aid of chemical experts

Sir Harold Hartley, who delivered the Theodore William Richards memorial lecture before the Chemical Society on April 25, gave an intimate and inspiring account of the social and scientific life of that great Harvard chemist, former president of the American Chemical Society, Davy and Faraday medallist, and Nobel prizeman, who died on April 2, 1928 He said that in Richards chemistry has lost a great experimenter the founder of a famous school of research, and one whose methods and example have exerted a profound influence on chemical investigations in every country His earliest investigation, suggested by Prof Josiah Parsons Cooke of Harvard, under whom he commenced his research career at eighteen years of age, consisted of a re determination of the atomic ratio hydrogen oxygen, and involved the weighing of globes of hydrogen, the passage of the gas over cupric oxide, and the weighing of the resulting water The excellence of the work was recognised by the award of a fellowship which enabled Richards to spend a semester at Gottingen, and to visit most of the important laboratories of Germany, Switzerland, France, and England He always advocated this plan of spending half a year abroad in intensive work in one institution, followed by half a year of peripatetic study, as generally offering the greatest advantage in the time available In 1901 he received an unusual compliment in the form of a call to a chair at Gottingen, but his services were retained at Harvard, where he remained for the rest of his life The investigation of atomic weights occupied the greater part of Richards's life, their fundamental nature appealing especially to his intense desire to know something more definite about the material and energetic structure of the universe, his first choice was copper, the study of which occupied several years, and was carried out with his typical thoroughness

Richards was responsible for devising the nephelometer as a means of overcoming certain difficulties in atomic weight work which arise from the slight solubility of the silver halides A second visit to Germany in 1895 gave him a new outlook, and he returned an enthusiastic, if critical, disciple of van 't Hoff and Ostwald All of Richards's early work had been performed under most trying conditions in Boylston Hall, but in 1912 the Wolcott Gibbs memorial laboratory, which in equipment convenience, freedom from fumes and dirt and from rapid temperature changes probably excels any other research laboratory in the world, was erected A constant stream of researches on atomic weights came from Harvard, but the solution of the problem of their relationships seemed no nearer Richards expressed his conviction that the periodic system represents only in a very crude fashion relationships which are highly complex and subtle The answer to the riddle

was, however, provided in 1912 by Russell, Fajans, and Soddy in their conception, independently, of isotopy Richards's interests were not confined to atomic weights, and his activities included investigations on electro chemistry, thermo chemistry, and ionic equilibria Four papers, entitled "The Significance of Changing Atomic Volume published in 1901–4, outlined the fields of physical chemistry with which he was most closely to be associated for the next twenty five years Many compressibilities up to 500 atm were measured from 1904 onwards, and fresh possibilities were opened in 1922 by Bridgman's researches on compressibility up to 12,000 atm during the last year of Richards's life much of his time was devoted to the analysis of Bridgman's results and his own earlier work, and the relative magnitudes of the internal pressures are found to correspond satisfactorily with the physical properties of the elements examined A long series of researches in thermo chemistry originated in his interest in the energy changes and changes in heat capacity accompanying chemical action, and their relation to his theory of compressible atoms He was in fact, the pioneer of modern precision calorimetry, and his electro chemical work is a most valuable contribution to our knowledge of amalgams His work, indeed constitutes a coherent attack on the constants of Nature

THE Annual Report for 1927–28 of the Agricultural Research Council of the Ministry of Agriculture consists of short summaries of the work in progress at the research stations and institutions in Great Britain in receipt of grants It is a lengthy document, full of interest both scientific and practical A perusal of this document would cause no little surprise to those who are loud in their complaints that the Government does little or nothing to benefit the agricultural industry, and would be enlightening to others who do not realise the extent to which research into the sciences associated with agriculture is assisted by government funds Scientific research however, is not always popular even among those who will ultimately benefit from it and unless it can be proved that the results of such work are of immediate service to the farmer he at any rate, is apt to be sceptical of its value Criticism of this kind, however is apt to neglect two important aspects of the problem which become of increasing importance in a country like Great Britain Under the various conditions of soil and climate, transport and markets, the agricultural industry is not really one, but consists of a large number of concerns differing largely in their needs, and in the character of the problems that beset them, so that results of research of vital importance to one section of farmers may be of little or no interest to others As time goes on and an ever greater call is made upon the products of the soil, and farming departs more and more from traditional and accepted methods, which were in the main designed to limit risk, and ensure economic stability, so will the industry depend to an increasing extent upon the results of scientific research It is in these two directions that the contents of this volume are of special interest, dealing as it does with almost all aspects of plants and animals in relation to the soil and to the means of their production

IT is perhaps invidious to single out the work of any single institution from this interesting account, but the Rothamsted work on the inoculation of lucerne, and that at East Malling on the manuring of apple trees, will appeal with great force to those interested in either of those problems In view of the economic pressure in the farming industry and the reversion of arable land to grass, and the attempts that are being made in the direction of intensive grassland production, the work at Cambridge, Aberystwyth, and Aberdeen will make a wide appeal It is now beginning to be realised that the problems connected with the management of a mixed herbage such as natural and artificial grassland are more difficult of solution than those of a single crop The work of these centres has made it clear that, given suitable soil and climate, it is possible to produce in grass all types of food for live stock, from that which is little better than straw to that which is more similar in character and composition to linseed cake It is surely a triumph for scientific work that this should have been possible, and should be a sufficient answer to those, ever decreasing in numbers who doubt the value of expenditure on research

A COMMITTEE has recently been formed, with Lord Cottesloe as chairman with the object of placing a memorial in the Tower of London to the memory of the Rev Alexander John Forsyth, the inventor of the percussion lock and primer for firearms Forsyth was born in 1769 at Belhelvie, Aberdeenshire, and died there on June 11, 1843 A graduate of King's College, Aberdeen, he succeeded his father as minister at Belhelvie He was interested in the scientific discoveries of his time, and was a chemist and a practical mechanic following up experiments made many years before in France, he succeeded in constructing a percussion lock which, with the use of detonating compounds, eventually superseded the old flint lock that had been in use for two hundred years Forsyth's invention was made in 1805, and in 1806 he carried out experiments in the Tower of London It was not until 1834, however, that the percussion lock was adopted for the British army Interest in his work has been renewed by the presentation to the Tower Armouries of examples of early English firearms by Prof Reid, of Aberdeen, one of the few surviving relatives of Forsyth The movement has the support of the Gunmakers Company and the Gunmakers Association, and particulars of the proposal for a memorial can be obtained from the Curator of the Armouries, Tower of London

ON April 24 Mr Dendy Marshall read a paper to the Newcomen Society on The Rainhill Locomotive Trials of 1829" These famous trials actually took place in October 1829, the four competing engines being the 'Rocket,' 'Novelty,' 'Sans Pareil,' and 'Perseverance' At that time the Liverpool and Manchester Railway was nearing completion, but though some fifty locomotives had been constructed

in England and many of these were in daily use at various mines and on the Stockton and Darlington line, the directors of the Liverpool line were still in doubt as to whether to use stationary engines with rope haulage or locomotives It was on the advice of the well known engineers Rastrick and James Walker that a prize of £500 was offered for a locomotive which should be "a decided improvement on those now in use, as respects the consumption of smoke, increased speed, adequate power and moderate weight" Of the four engines entered, only the 'Rocket' fulfilled all the conditions and went through the trials satisfactorily, a performance which did much to establish the locomotive in an unrivalled position as the motive power of the future The design was due to the collaboration of George and Robert Stephenson and Henry Booth, and the engine was the first locomotive containing the present features of a roomy fire box combined with a tubular boiler The 'Rocket' was employed on the Liverpool and Manchester Railway until 1836, when it was sold for £300 It then worked on the Midgeholm Colliery until 1844, and in 1862 was secured by Bennet Woodcroft for the Patent Office Museum, from which it passed to the Science Museum, where it is one of the most attractive of many historic relics of the past Simultaneously with the meeting of the Newcomen Society in Caxton Hall, the American members of the Society held a meeting in New York, at which Mr Dendy Marshall's paper was also read An abridgment of the paper appeared in the *Engineer* for April 26

THE atmosphere of incredulity surrounding the subject of the 'sea serpent' tends to obscure the fact that several varieties of true sea snake are frequently met with in the Indian Ocean and other tropical waters Little, however, is known of their habits, a deficiency which adds interest to a recent report from the steam trawler *Humphrey*, Capt John MacDonald On Dec 22, 1928, while steaming eastward from Torres Strait, a commotion was observed in the water about four miles from Double Island, and on closing it a large fish was seen to be struggling in the coils of a sea snake, which was engaged in rapidly striking the fish's head with its own On the ship's approach, the snake sank slowly with its prey, which it had apparently succeeded in stunning The snake is described as being striped with bright yellow and dull brown, in rings, a coloration which points to its having been a *Platurus fasciatus* Later in the same day, several similar snakes were seen, ranging from three to nine feet in length According to the *Humphrey*, they are not uncommon in these waters, and craft at anchor are accustomed to plug their hawse pipes in order to prevent the snakes, whose bite is reputed to be poisonous, from coming on board by climbing the anchor cables

AT a meeting of the Linnean Society of London on April 18, Sir Sidney Harmer read extracts from correspondence relating to the habits and probable end of "Pelorus Jack," probably a specimen of Risso's dolphin, which for many years accompanied ships through Pelorus Sound, at the northern extremity of South Island, New Zealand "Pelorus Jack" was shot at several times, but after 1904 was protected by successive Orders in Council of the Government of New Zealand The animal used to escort steamers appearing in the Sound for about 5 miles, leaping and gambolling under their bows It is thought that it was killed about April 1912, possibly by a twin-screw steamer which took the place of a single screw vessel formerly plying on a route passing through Pelorus Sound In the discussion which followed, Dr G P Bidder referred to an experience of his own off Plymouth in a 3 ton cutter Five or six porpoises played close alongside, one within reach from the steersman's seat, but none touched the boat Mr H N Ridley stated that off the Dindings, on the coast of the Malayan Peninsula, his launch had been repeatedly escorted by dolphins, which rubbed against the boat and played so close to it that they could be slapped The general opinion was that dolphins do not rub against vessels to clear themselves of barnacles, as has often been suggested Dr Bidder stated that the size and character of the dolphin's brain are such that it is capable of delighting in exhibiting skill and may be attracted to a ship by its noises The classical stories of the friendliness of dolphins towards mankind may not be quite so incredible as we have supposed

THIS year the State of Western Australia celebrates its centenary An article in the *Nineteenth Century* for April by Mr J W Kirwan recounts some of the remarkable developments in that part of Australia during the last hundred years Although known to the Portuguese and Dutch at least from the seventeenth century, no notice was taken of Western Australia until early in the nineteenth century It was only in May 1829 that formal possession was taken by Great Britain of the west coast of New Holland and a settlement was founded on Swan River At the end of that year the new colony contained only 850 settlers The struggle that faced them was severe Knowledge of conditions had to be learnt slowly, and the aborigines were none too friendly After five or six years the colony had made little progress Then the introduction of penal labour improved matters, and most of the new settlers turned into good colonists But it was the gold rush in the eighties and nineties of last century that set the colony on its feet and raised it from poverty and stagnation to prosperity and progress The gold rush brought men of ability and enterprise as well as others of little value Public works were undertaken, the agricultural wealth of the State was realised, and steady and continuous development begun. The population is now above 400,000 and there is ample space for many more

ON April 24 a Fairey monoplane, piloted by Squadron Leader A G Jones Williams and Flight Lieutenant N H Jenkins, left Cranwell Aerodrome, Lincolnshire, with the intention of making a non stop flight to Bangalore, India According to the Karachi correspondent of the *Times*, they passed over that city on the afternoon of April 26, and shortly afterwards returned and descended owing to lack of

petrol They had flown a distance of approximately 4130 miles in 50 hours 48 minutes, Karachi was reached in a little more than 48 hours The mono plane was specially designed for the journey, and was fitted with a Napier Lion engine giving 530 h p at full throttle Its weight when fully loaded was about 16,000 lb, and it is estimated that a further 1000 lb of fuel could have been carried had a suitable runway been available for the start The average speed for the first 2000 miles was 96 miles an hour, but along the Persian Gulf the average dropped to 70 miles an hour, the airmen travelling at a height of about 10,000 feet, being unaware of a favourable wind up to about 6000 feet

Recent additions to the Department of Entomology of the British Museum (Natural History) include a further batch of insects presented by Mr R E Turner, which, with the consignment announced last autumn, makes a total of 13,946 insects of various orders collected by him in South and South west Africa during 1928 Upwards of 6000 of these specimens are Hymenoptera, upon which Mr Turner is a well known authority, while some 4000 are Coleoptera (beetles) But all orders of insects are represented in this donation, which, when fully worked out, will form a most valuable contribution to the knowledge of the insect fauna of the southern extremity of the African continent, especially since many of the specimens were obtained in localities where little if any collecting has hitherto been done Prof V M Goldschmidt, of Oslo, has presented to the Mineral Department of the Museum both rough and faceted specimens of olivine of gem quality recently discovered in western Norway Mr G Tandy, of the Department of Botany, who has recently spent five months with the Great Barrier Reef Expedition, has brought back a large number of specimens illustrating the marine flora of the Reef and adjacent areas, which are being added to the botanical collections

It is announced that the first Congress of the International Society for Microbiology, which was fixed to take place in Paris in October 1929, has been definitely postponed to June 25, 1930 The programme, which has already been published in various scientific journals, will stand

After fifty years in the service of the Royal Institution, Mr Henry Young is about to retire from his post as assistant secretary and keeper of the library He was engaged as an assistant in the library in 1879, when Tyndall was the resident professor, and was promoted ten years later to the position which he now occupies He has been a devoted servant to the Institution and a familiar friend to a large number of the members The Royal Institution is full, as is well known, of interesting and honourable traditions, and Mr Young has been and still is one of the chief agents of their preservation In his place Mr Thomas Martin, at present secretary to the Institute of Physics, has been appointed as general secretary, Mr Ralph Cory, assistant in the library, becomes librarian.

Applications are invited for the following appointments, on or before the dates mentioned:—A first assistant in the Clinical Laboratory of the Manchester Royal Infirmary—The General Superintendent and Secretary, Royal Infirmary, Manchester (May 8) A public analyst for the City of Salford—The Medical Officer of Health, 143 Regent Road, Salford (May 11). A ballistic research officer under the Ordnance Committee—The Secretary, Ordnance Committee, Royal Arsenal, Woolwich, S E 18 (May 11) A lecturer in pharmacy at the Belfast Municipal College of Technology—The Principal, Municipal College of Technology, Belfast (May 14) An assistant morbid anatomist and curator of the museum of the Royal Free Hospital and London School of Medicine for Women—The Secretary, Royal Free Hospital, Gray's Inn Road, W C 1, or The Warden and Secretary, London (R F H) School of Medicine for Women, Hunter Street, W C 1 (May 15) A lecturer in biology at the Portsmouth Municipal College—The Secretary, Offices for Higher Education, Municipal College, Portsmouth (May 25) A technical officer and a junior technical officer at the Royal Aircraft Establishment, for work relating to the development of instruments and allied equipment for aircraft use—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants (May 25) An assistant lecturer in physics in the University of Manchester—The Registrar, The University, Manchester (May 25) An assistant lecturer in zoology in the University of Bristol—The Secretary, The University, Bristol (June 1) An assistant lecturer in economics at the University College of North Wales, Bangor—The Registrar, University College of North Wales, Bangor (June 8) An assistant in natural history at University College, Galway—The Secretary, University College, Galway (June 8) An assistant in the Mechanical Engineering Section of the Engineering Department of the Halifax Municipal Technical College—The Principal, Municipal Technical College, Halifax A master for building subjects in the Southall Junior Technical School—The Principal, Junior Technical School, Southall, Middlesex A resident lecturer in science, biology and botany, elementary chemistry and physics, at St Gabriel's Training College for Women—The Principal, St Gabriel's Training College for Women, Camberwell A lecturer on physics and chemistry at the Maria Grey Training College—The Principal, Maria Grey Training College, Salusbury Road, N W 6 A technical assistant in the Department of Entomology of the Museum of Zoology, Cambridge—C Forster Cooper, Superintendent, The Museum of Zoology, Cambridge An experienced shorthand typist secretary for library work, indexing and correspondence, at the Research Station, East Malling—The Imperial Bureau of Fruit Production, Research Station, East Malling, Kent

Erratum—In the article on "High Voltage Alternators for the Grid" in Nature of April 13, p 586, "25 kilowatts" on line 33, and "10 kilowatts" on line 34, of the second column, should read "25,000 kilowatts" and "10,000 kilowatts" respectively

Research Items

A REMARKABLE OBJECT FROM BENEATH THE RED CRAG.—In *Man* for April, Mr. J. Reid Moir describes a remarkable object obtained from beneath the Red Crag at a pit on the north bank of the River Gipping at Bramford, near Ipswich. It was obtained from the detritus bed lying below loamy sand, which in turn was below glacial gravel. The bed lies at about 100 O.D. upon the surface of the London Clay. It is made up of typical sub-crag detrital material and does not exhibit any signs of glacial disturbance. The object was discovered in 1926, but beyond being labelled was not specially noted until attention was directed to its remarkable character by the Abbé Breuil, who, on examining it, pronounced it shaped by the hand of man. In shape it is like an elongated egg with one end slightly blunter than the other. At each end is a small depression or punctuation, and similar marks are visible on other parts—in places four or five being grouped together as a rhomboid or as straight lines. It is possible that these may be due to decomposition of crystalline grains. The whole surface has been scraped with a flint, so that it is covered with a series of facets running fairly regularly from end to end. From each one is made up a number of longitudinal striations of unequal depth; a number of fine concentric incisions are visible at one of the poles. The specimen is of a greyish-brown colour, weighs approximately ½ ounce, and measures at its greatest length $1\frac{7}{16}$ in., and at its greatest depth $\frac{13}{16}$ in. The exact nature of its material is in doubt. The Abbé Breuil compares it with the steatite sling stones of New Caledonia.

TLINGIT EMBLEMS.—In the *Museum Journal* (Philadelphia) for December last, Mr. Louis Shotridge describes a number of ancient clan emblems of the Tlingit of Alaska: these formed part of a collection of ancient objects representative of the traditional art of this people which he was able to collect solely in virtue of the fact that he himself was a Tlingit of noble birth. These objects, it is stated, had not seen the light since the introduction of the white man's religion and law. The emblems are in the form of ceremonial head-dresses, each of a once generally recognised grade in rank and importance. The Tlingit were divided into two nations, each of which was subdivided into clans. Each clan had its ceremonial head-dress, but its possession was often the subject of dispute and the cause of internecine war. On the side of the Tlingit naedi nation, first in importance was the raven hat, which signified culture; next in order the whale hat, an emblem of greatness and the cult object of the greatest clan. The frog hat signified persistence and was the emblem of the Kiks adi clan. On the side of the Shungookaedi nation were the eagle, the grizzly bear, the emblem of power, and the wolf, signifying courage. The hats are for the most part woven of roots of the spruce, with highly conventionalised representations of the head or other part of the animal simulated carved in wood and ornamented with locks of human hair. On most there was a 'top stock' of spruce roots, woven to resemble a number of interlocking cylindrical boxes superimposed which could be made to expand or contract. The number of these boxes or divisions represents the number of ceremonies in which each hat was used.

LESSONS FROM THE HUMAN FOOT.—In the third lecture in memory of Hugh Owen Thomas, delivered before the Medical Institution at Liverpool on May 11, 1928, Sir Arthur Keith discussed some of the problems of the human foot (*Jour. Bone and Joint Surgery,* January 1929). He looked upon the sequence of postural functions as a more promising line of investigation than anatomical details, and took it as proved that the human foot had been evolved from a prehensile foot, the nearest representative of the primitive form being that of the chimpanzee. The chief changes which transformed the prehensile into plantigrade were due to growth—a recession of growth of the external or planar limb of the prehensile foot with a progressive growth in the hallucial limb. Three stages of this growth development can be followed: the pronograde prehensile foot, the small orthograde foot (hylobatian), the massive orthograde foot (troglodytian) leading to the human plantigrade. The mass of the body has been the most important factor in bringing about the later changes, and it is inferred that it was the weight of the body which compelled man's anthropoid ancestors to assume terrestrial habits of life, and that man is the descendant not of a pigmy anthropoid but of one of massive body.

RURAL POPULATION OF NEW YORK STATE.—In a study of the movements of population in New York State from 1855 to 1925 (Cornell University Agricultural Experiment Station *Memoir* 116) Mr. B. L. Melvin brings to light a number of interesting facts especially with regard to recent years. While the population of New York State increased 7.5 per cent from 1920 to 1925, the total city population, including New York City, grew less than did other classes, and the larger cities gained less than the smaller ones. Suburbanisation was the most marked phenomenon in the shifting of population in that period. As a result, rural population increased, especially in those counties where urban influences were most dominant. That this increase was due to urban influences, provided no doubt by improved transport, seems to be clear from the fact that farm population increased only in suburban counties but decreased in all others. Cities seem to maintain the farm population near them rather than to cause its decline. In such a study, of course, the use of terms is somewhat arbitrary. Mr. Melvin classes as rural population all persons living outside places of population 2500 and above. The pamphlet is well illustrated with distributional maps.

MIGRATIONS OF THE ARCTIC TERN.—A *Daily Science News Bulletin*, issued by Science Service, Washington, D.C., announces that an Arctic tern ringed as a fledgling at Turnevik Bay, Labrador, on July 28, 1928, was found dead on the beach at Margate, fifteen miles south-west of Port Shepstone, Natal, South Africa, on Nov. 14, 1928. This is a remarkable record, not only for the distance covered, but also for the fact that the bird could have been only about three months old at the time of the flight. It suggests the possibility that the birds, which are rarely or never seen on the south Atlantic coast of the United States, may cross the ocean to Europe and then proceed south. The extensive migrations of the Arctic tern are well known, and owing to its habit of breeding in the northern portion of the northern hemisphere and of wintering in the far south, it enjoys more hours of sunlight than any other living creature. In the northern part of its breeding range and during its stay in the Antarctic regions, it lives practically in continuous daylight.

GENITALIA AND GENITAL DUCTS OF INSECTS.—C. J. George (*Quart. Jour. Micr. Sci.*, vol. 72, part 3) has examined the development and morphology of

the genitalia of Homoptera, as represented by the frog hopper, *Philænus*, and of Zygoptera as represented by *Agrion* (one of the demoiselle flies) and sets down the homologies of the parts As the result of studies on the development of the genital ducts, he concludes that the vaginal opening in Orthoptera, Hymenoptera, Homoptera, Diptera, and Lepidoptera is homologous, and that the vaginal opening in Coleoptera is homologous with the oviducal opening of Lepidoptera and with the opening of the accessory gland of Homoptera, Hymenoptera, Diptera, and Isoptera The common oviduct, being formed differently in the different groups, is not homologous, and the accessory organs, for example, spermatheca, are not homologous The author discusses the probable lines of evolution of the female ducts in Insecta, and points out that the Ephemeroptera with their double female openings on the seventh abdominal segment exhibit an ancient condition, and that many higher insects pass through this condition during their larval and nymphal stages The existence of an ectodermal invagination behind the seventh abdominal segment in Homoptera and Orthoptera shows that the acquisition of a single gonopore was the next step The later ontogenetic history shows that there has been a tendency to shift the gonopore to the terminal abdominal segments The conclusion is that the Orthoptera, Homoptera, Lepidoptera, and Diptera are closely allied, but the Coleoptera have had a different line of evolution

CHROMOSOME LINKAGE IN *ŒNOTHERA* HYBRIDS —Prof R R Gates and F M L Sheffield, in *Phil Trans Royal Soc*, B, vol 217, 367 (1929), have published an account of important cytological researches on reciprocal hybrids obtained from *Œnothera ammophila* and *Œ* (*biennis* × *rubricalyx*) The reciprocal F_1 hybrids are very different and are patroclinous The chromosome linkages were found to be unlike in the reciprocal hybrids In *Œ ammophila* × (*biennis* × *rubricalyx*) the spireme segments in diakinesis into three free pairs of chromosomes and a ring of eight In the reciprocal cross there are, on the contrary, seven chromosome ring pairs That the latter has all its chromosomes paired makes it clear that complete pairing is not necessarily a sign of the homozygous condition The conclusion is reached that since the same two haploid sets of chromosomes are present in the reciprocal hybrids, the cytoplasm plays a part in determining what pairing shall take place, it influences the attractions between the chromosomes and the distribution of chromosomes in the reduction division This leads in itself to a departure from usual Mendelian behaviour The production in F_1 of true breeding hybrid types is to be explained through the occurrence of chromosome linkage, which prevents free assortment of the chromosome pairs, and hence of the differential characters Linkage differences in *Œnothera* occur in wild species as in mutations arising in controlled experiments It seems, therefore, that evolution can occur through germinal changes (mutations) of various kinds arising in a succession of species which are of natural hybrid origin, but, in the main, breed true because of their persistent chromosome linkages in meiosis In this probable sequence we have suggested a new evolutionary phenomenon which may be of much significance for the student of the origin of species

A NEW 'DEEP' IN THE PACIFIC —A *Daily Science News Bulletin*, issued by Science Service, Washington, D C, announces that the non magnetic ship *Carnegie*, now cruising in the Pacific Ocean, has discovered a new deep some fifty miles west of Tahiti The greatest depth was 5400 metres, and its area does not seem to be extensive The observations were made with the sonic depth finder Captain Ault named the depression the Bauer deep, after the director of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington A further discovery was that of a submarine ridge in approximately lat 23° S and long 80° W This seems to be a northward extension of the ridge on which the San Felix Islands lie It was named the Merriam ridge Other oceanographical discoveries were made, but details are not yet given

ICE IN THE ARCTIC SEA —The Danish Meteorological Institute has published in the *Nautisk Meteorologisk Aarbog*, 1928, its usual report on the state of the ice in Arctic Seas during the year Most of the observations are naturally for the summer months, but off south west Greenland, western Spitsbergen, and in the North Atlantic it is possible to give reports for all months In the Barents and Kara Seas there was less ice than usual in the summer Franz Josef Land could be reached in August, while in September there was even water between some of the islands of the archipelago In Spitsbergen waters conditions were favourable except for unusually late streams of pack ice on the south west coast In August and September Spitsbergen could be circumnavigated without difficulty The east coast of Greenland had rather more ice than usual, and this state of affairs was found also in the east of Spitsbergen On the other hand, there seems to be no evidence of an increased outflow of pack ice by the other outlets of the Arctic Sea Davis Strait and Baffin Bay had rather less ice than usual Reports from the Bering Sea are few and vague Iceland coasts were practically free throughout the year On the Newfoundland Banks pack ice was below the normal in every month, but icebergs were much above the normal in April, May, and June The report is illustrated with the usual charts for the spring and summer months

RAMAN EFFECT AND THE SPECTRUM OF HYDROGEN —In NATURE, Jan 26, p 127, Prof H S Allen suggested the view that many of the faint lines in the secondary spectrum of hydrogen may result from the bombardment of hydrogen molecules by light quanta of frequencies corresponding to the Balmer lines A table was given for the first five Balmer lines showing a number of possible Raman lines having frequency differences with respect to the exciting line which were integral multiples of a particular wave number Dr D B Deodhar, Physics Department, University of Lucknow, in a letter to the Editor, states that he has made a further search in this direction, using the recently published wave length tables of Finkelnburg, and for ten members of the Balmer series has found a large number of lines, both of lower as well as of higher frequencies, which approximately occupy the positions of Raman lines Finkelnburg's experimental tube was energised with 2000 volts, giving a discharge current of 600 ma, while the current in Gale, Monk, and Lee's tube was only 20 ma Finkelnburg discovered about 2000 lines which were previously unknown in the spectrum of hydrogen The intensity of the Balmer lines in his experiments was considerably greater than in those of Gale, Monk, and Lee It is interesting to note that a majority of the Raman lines of *increased* frequency belong to the newly discovered lines, and that they are of very low intensity Dr Deodhar expresses the opinion that his results strongly corroborate the view put forward by Prof Allen, but, in consideration of the high accuracy of recent measurements of wave lengths in the hydrogen spectrum, it may be well to scrutinise such results very carefully

MOLECULAR RAYS —Some experiments performed with beams of molecules by Prof O Stern and F Knauer (*Zeitschrift für Physik*, Mar 7) furnish good qualitative evidence that particles of atomic dimensions, as well as electrons, behave as waves in certain circumstances The de Broglie waves of a hydrogen molecule at room temperatures gave an average wave length of about 1 A, and should therefore be reflected specularly from a well polished mirror if they are incident upon it at an angle of the order of a thousandth of a radian, as are X rays of corresponding wave length This has been shown to be the case, the efficiency of reflection is greater the less the glancing angle, and the angle at which reflection first becomes marked is about that which would be expected from the size of the irregularities on the polished surface, whilst the amount of reflection increases as the temperature of the beam of molecular rays is lowered, that is, as the equivalent wave length of the particles is increased Prof Stern was unable to obtain any positive results in an attempt to diffract molecules from a ruled grating, but his results with a crystal surface, although not quite definite, are compatible with the idea that diffraction takes place in this case

LOAD AND TARIFF IN ELECTRIC SUPPLY —The standard method of distributing electrical energy in Great Britain is by means of three wires carrying alternating currents, the phases of the currents in each wire being different The consumer's load can either be connected in mesh (like a triangle) or in star (the three wires being joined together at one point) When the load is balanced, the measurement of the power taken presents no difficulty When, however, the power expended in each of the three arms is different, the problem becomes complex and the ordinary methods of measurement give no useful or sufficient indication of the nature of the load taken by a consumer In addition to the values of the three currents in the arms, we have to take into account the phase differences between these currents and the electromotive forces driving them This problem, which is almost purely mathematical, was discussed in a paper by E W Hill, read to the Institution of Electrical Engineers on April 5 The solution arrived at, however, whilst possibly better than some of the methods at present in use, appears to us not to classify consumer's loads in a truly equitable way If the assumption is made that all the waves follow the harmonic law, the solution given by Russell, which is referred to in the paper, seems to be a satisfactory one The general case, however, yet remains to be solved, although a very large number of papers have been written on the subject, especially in America There are few industrial applications where mathematics can be more usefully employed than in electrical engineering

GEOGRAPHICAL INFLUENCES AND RADIO WAVES —In the *Revue Scientifique* for Mar 23, R Bureau, of the French meteorological office, gives data which show that ordinary meteorological and geographical causes exert a very appreciable influence on the propagation of radio waves In the early days the hypothesis of a conducting layer in the upper atmosphere was a great help in enabling us to picture how part of the radio energy flowed round the earth With waves the frequency of which exceeds 6000 kilocycles (wave length less than 50 metres) it gives a fairly satisfactory explanation of the 'zones of silence' observed in practice It is now accepted, however, that the height of this layer is a quantity varying at different times of the day and that there are possibly several conducting layers at different heights Apart, however, from what happens in the upper atmosphere, important effects are produced in the troposphere, which is about six miles in height, and in the lower layers of the stratosphere Contrary to expectation, direct experiment has shown that the surface which separates the stratosphere from the troposphere has little, if any, effect on the propagation of the waves It is found that short waves, whether entering or leaving France, have very different properties, which depend on their direction of propagation Waves coming from the Caribbean Sea, Panama, and the Gulf of Mexico suffer little attenuation On the other hand it is, if not impossible, at least very difficult to get signals from the north east of the United States and from Newfoundland Signals given by a 200 watt emitter on the Atlantic coast of Morocco seem never to reach central or eastern Europe, although they can be heard in other directions for thousands of miles The radio waves seem to have difficulty in passing through the surface of separation between a mass of cold air and a mass of warm air The lines which separate the audible zones from the zones of silence often coincide very closely with the meteorological lines separating masses of cold and warm air

CRYSTAL STRUCTURE OF β THALLIUM —At the ordinary temperatures, α thallium has a hexagonal close packed lattice Drs Nishikawa and Asahara have shown by X ray methods that it has an inversion point at about 230° C The change in crystal form consequent upon this has been investigated by Mr Sinkiti Sekito, of the Research Institute for Iron, Steel, and other Metals, Sendai, Japan, who has sent us a short communication on the subject The metal was retained in the form stable above the inversion temperature by quenching it in iced water Photograms were then prepared, using a chromium anticathode and taking the wave length as $CrK_{\alpha} = 2\ 287$, $CrK_{\beta} = 2\ 080$ It appears from these that β thallium has a face centred cubic lattice ($a = 4\ 841$) Calculating the specific gravity from this value, the figure 11 86 is obtained, which agrees well with the results obtained by other methods A similar face centred cubic structure was obtained with thallium alloys containing bismuth, lead, antimony, or tin in solid solution Mr Sekito concludes, therefore, that the face centredness of thallium above 230° C has been definitely established

HYDRATES OF CADMIUM SULPHATE —The hydration of cadmium sulphate was for long the subject of controversy, until Hauer and also Rammelsberg showed that, at ordinary temperatures and pressures, this salt crystallises from its solutions as the monoclinic hydrate, $CdSO_4$, 2 67 H_2O This result was confirmed by later investigators and, as a consequence of vapour pressure measurements by Carpenter and Jette in 1923, the temperature of transformation into the monohydrate was given as 41 5° A systematic study of the dehydration of this salt, carried out by Prof Luca Coniglio, is recorded in the *Rendiconti* of the Academy of Physical and Mathematical Sciences of Naples for January–April 1928 The experimental data show that at 74°, $CdSO_4$, $\frac{8}{3}H_2O$ loses $\frac{5}{3}H_2O$, giving the monohydrate, which is stable until the temperature reaches about 120°, when further expulsion of water occurs, with formation of $3CdSO_4$, $2H_2O$ The latter hydrate is stable at temperatures below about 138°, when another molecule of water is lost, giving $3CdSO_4$, H_2O, which is converted, but only comparatively slowly, into the anhydrous salt at 150° It seems probable that the water of crystallisation of the original salt is combined, not with a single molecule, but with three molecules, of the cadmium sulphate, the formula being $3CdSO_4$, $8H_2O$

Developments of British Chemical Manufactures

AT the instance of the British Science Guild, a public meeting was held at the Mansion House, London, on April 24, when an account was given of certain phases in the development of British chemical industry Lord Melchett, who presided referred briefly to the origin and the present status of the nitrogen industry, remarking that although the synthetic ammonia industry has grown up in the last few years, the problem of the supply of artificial fertilisers is by no means new Nevertheless, older sources of combined nitrogen were inadequate, and had the new industry not been created the fields of the world would soon have starved for one of the most elemental necessities The new textile also, originally a British conception, has proved applicable in numerous directions, whilst the drug industry is proceeding in the direction of the synthesis of highly complex substances Other manufactures are equally dependent on the prosecution of scientific research, and the value of such research should be more fully realised

Sir Frederick Keeble then addressed the meeting on "Fertilisers from the Air," saying that, like the legendary discovery by Prometheus of fire, fertilisers have been brought down from heaven by modern chemists Without sufficient nitrogen in the form of salts of ammonia or nitrates, the green plant is unable to manufacture sugars and proteins at its maximum capacity lack of available nitrogen has always limited life on this planet Natural processes are too slow for the modern world, and before the year 1913 a general nitrogen hunger had become apparent Now, however, the nitrogen of the air is being made into fertilisers at the rate of more than one million tons a year, drawing on a supply so vast that, at the present rate of use, it will last for four thousand million years Farmers are now acquiring the habit of using larger quantities of nitrogenous and other fertilisers, Holland leads the way, followed by Belgium, Germany, Japan, Egypt, Great Britain, and France, whilst the use of nitrogenous fertilisers in the United States of America is well below that of Western European countries The material is now one of our cheapest commodities, and thus provides the farmer with the best means of reducing costs and of obtaining improved economic results from his farm Sir Frederick then outlined the origin and development of the great factory at Billingham, where attention is now being directed to the manufacture of fertilisers containing other plant foods in addition to nitrogen

The 'rayon' (artificial silk) industry was described by Mr A B Shearer, who insisted that the use of the expression 'artificial silk' only keeps alive an erroneous impression of inferiority, since the new textile is no more artificial than is steel or many other manufactured products, and since it possesses none of the chemical, and few of the physical, characteristics of silk The four principal processes involved, in order of their industrial development are those known as the nitrocellulose, cuprammonium, viscose, and cellulose acetate processes Nitrocellulose was first used in 1883 to produce a continuous cellulose thread by Sir Joseph Swan, who in 1885 exhibited fabrics made from his yarns, whilst a year later Count Hilaire de Chardonnet became the first producer of rayon for textile purposes After briefly indicating the nature of the processes employed in the production of these textile fibres, Mr Shearer emphasised the debt which the new industry owes to scientific discovery, and showed how the new fabrics successfully minister to the needs created by changes in the habits and outlook of civilised peoples The difficulties of establishing a new industry are seldom realised, but it must be placed to the credit of British organisation, business foresight, engineering skill, textile technology, and salesmanship, that Great Britain has been able to take and maintain the lead in this great industry Moreover, the use of rayon has had a marked effect on the general condition of the textile industries, its special requirements leading to generally applicable improved methods of manufacture and treatment, in the application of which the worker has benefited

Mr F H Carr spoke of developments in the study and manufacture, particularly in Great Britain, of synthetic drugs The great success of salvarsan provided a strong incentive for the search for other synthetic drugs which exert an antagonistic effect on disease organisms without injuring the infected person, for example, various organic compounds of arsenic and antimony are now employed, especially in the treatment of certain tropical diseases In its normal chemical processes the body is continually producing active principles, chemical substances, which control and regulate its action A study of these substances has led to the possibility of their replacement, in cases of deficiency, by synthetic, or at least externally prepared, substances Insulin has not yet been made synthetically, but adrenaline, secreted by the suprarenal gland, has been synthesised, and, moreover, nearly related compounds with other valuable medicinal properties have been prepared Mr Carr also referred to the synthesis of ephedrine, an alkaloid which occurs in the Chinese plant Ma huang, this substance powerfully relieves the distressing effects of asthma Vitamin D is now made by the action of ultra violet light on ergosterol, a substance derived from yeast

Mr Carr sketched the progress of the medicinal chemical industry in Great Britain, and remarked that to day there are important manufacturing firms which, between them, are making most of the synthetic drugs The fact that there are some exceptions, chiefly substances derived from intermediates employed in the manufacture of dyes, shows that the organisation of chemical industry in Great Britain, although it has made rapid strides, has not yet been completed The changes which have occurred in chemical industry of late years are in large measure the result of the mutual approach and understanding which have already taken place between the business, the scientific, and the practical men in the industry Future progress lies in extending the use of science in the industry, in the first place by promoting research in industrial laboratories in the closest possible relationship with that carried out in academic institutions and under the ægis of the Medical Research Council, and, secondly, by finding employment for greater numbers of scientifically trained staffs and workers to whom is given responsibility and a living interest in the work they are performing

Sir Richard Gregory, who proposed a vote of thanks to the chairman, said that the fact that scientific research leads not only to new outlets for employment but also to the creation of entirely new industries is too often overlooked by politicians British scientific capacity is at least as great as that of any other people in the world, and he hoped that it would be yet more fully employed in such development and creation

Radium Requirements of Great Britain

ON July 7, 1928, the chairman of the Committee of Civil Research appointed a sub committee, with the Right Hon Lord Rayleigh as chairman, to examine the radium requirements of Great Britain in relation to the present sources of supply and to submit recommendations The Report of the Radium Sub Committee (dated Mar 7, 1929) has now been published (London H M Stationery Office 6d) The document is of absorbing interest, for it not only discusses the importance of radium in medical treatment and the amount required for such purposes in Great Britain, but it also presents a valuable survey of the sources of radium production, with special reference to deposits in the British Empire Among the conclusions reached are the following

The amount of radium belonging to the Government which is available for medical purposes in England, Scotland, and Wales is 2 2 grams, and the estimated amount believed to be the property of hospitals and private medical practitioners, or likely to be so in (say) three months' time, is approximately 22 7 grams, making a total of 24 9 (or say 25) grams

The amount required to meet existing needs in Great Britain is probably approximately 49 or 50 grams, that is, an immediate addition of about 24 grams to the existing national stock is required

Owing to the lack of trained personnel and to the inadequacy of the available hospital accommodation it is probable that not more than 20 additional grams of radium could be effectively absorbed for medical purposes by the end of 1930

There exists a pressing need for the establishment of a central stock of radium and the organisation of some systematic method for its distribution

Until sources of supply at present unproved or unknown are discovered in the Empire or elsewhere, the only source from which additional supplies of radium for medical purposes are obtainable in any quantity is the Belgian Congo

The following are the chief recommendations submitted

Steps should be taken at once to ensure the acquisition by instalments of 20 additional grams of radium element for medical purposes

A body of trustees should be appointed entitled the National Radium Trustees, whose duty it should be to hold the funds provided by Parliament or otherwise, and to purchase therewith and hold radium for use by the Radium Commission referred to below

The National Radium Trustees should appoint a body to be called "The Radium Commission," who should have the following powers and duties

Generally to deal with the custody, distribution, and use of all radium held by the trustees, having regard to the advancement of knowledge, the treatment of the sick, and economy of use , and, in particular to consider and approve plans submitted to them for the use of radium for the purposes of medical treatment and research and to make the necessary arrangements for the supply of radium for such uses

As was announced in our issue of April 27, p 649, the Government has accepted the financial recommendation of the Sub Committee, and will contribute £1 for every £1 of private subscription up to £100,000 for the purchase of radium This leaves a sum of £150,000 to be raised by private subscription if the quantity of radium required is to be purchased A double appeal has now been issued An anonymous donor has given £100,000 to King Edward's Hospital Fund for London to form the nucleus of a thank offering fund for the recovery of His Majesty the King, and the *Times* has undertaken to raise the £150,000 required for the National Radium Fund The two movements are in close co operation and have the same treasurer and office organisation The King has signified his approval of the scheme by sending a cheque for £1000, to be divided equally between the two appeals, and other members of the Royal family have contributed The eagerness of the public to express its thankfulness for the King's restoration to health has been marked by its swift response to the appeals, nearly £60,000 being subscribed to the National Radium Fund on the day it was opened Further subscriptions, for either fund, should be addressed The Treasurer, Thank offering Fund, 103 Kingsway, W C 2

Annual Meeting of the International Council for the Exploration of the Sea

THE annual meeting of the International Council for the Exploration of the Sea was held in London on April 8–15 The meetings of the area and other committees took place at the House of Lords, and the rooms of the Zoological Society were placed at the disposal of the Council for the scientific meetings held on April 12 and 13 About sixty delegates and experts attended the meetings

The main work of the Council is organised on a regional basis, and the investigations carried out in each geographical area are reviewed by the area committees, which also lay down the programmes for the ensuing year Hydrography, plankton, statistics, and the study of salmon and trout are dealt with by special non area committees

At the Hydrographical Committee, the main points under discussion were the preparation of mean surface salinity charts for the North Sea, plans for combined work on submarine waves in the Kattegat, and the hydrography of the Faroe Shetland Channel , regular observations of the surface waters on two additional lines in the North Sea were arranged Prof W Mielck presented a report to the Plankton Committee on the work he has carried out in testing the comparative catching power of various types of plankton nets, and Prof H H Gran initiated a discussion on quantitative methods used in the investigation of phytoplankton In the Atlantic Slope Committee under the chairmanship of Dr E D le Danois, Prof A Ramalho gave an account of the Portuguese hydrographical work in the area, including the Straits of Gibraltar and the adjacent Portuguese, Spanish, and Moroccan coasts, and Dr Fernando de Buen demonstrated an inverse correlation between the catches of sardines and sprats, as shown by both English and Portuguese statistics Dr R S Clark gave a detailed account to the Northern North Sea Committee, of the distribution of the young herrings of the northern waters of Great Britain, and Dr A Molander contributed notes on the witch fishery of the area Dr A Bowman, the chairman, read a paper on the age determination of the lemon sole by means of scales In the meetings of the Southern North Sea and Combined North Sea Committees the advisability of continuing the practice of issuing advance proofs of the tables from the *Bulletin Hydro*

graphique to people concerned, was discussed It was decided that this procedure was very helpful and should continue

Prof A C Hardy showed a new model of his continuous plankton recorder, which it is hoped will be of great service in enabling plankton collections to be made from commercial vessels A question which is becoming of great practical importance, namely, the design of fishing gear which will avoid the wasteful destruction of small fish, was discussed by a special Committee on Savings Gear, in the light of experiments carried out in several countries during the past year

Special interest attaches to the recommendations of the Whaling Committee, in view of the recent great expansion of the industry, especially in the Antarctic The Committee expressed the view that, while investigations are not sufficiently advanced to enable definitive and adequate regulations to be framed for the conservation of the stock of whales, there are certain practical steps, for example for the protection of young and immature whales, which might be taken at once by international agreement, and it asked the Council to impress this point of view upon the governments concerned It proposed also the organisation of adequate statistics of the catch of whales in all parts of the world

At last year's meeting the innovation was made of devoting two days to the discussion of subjects of general scientific interest affecting the Council's work, and the same useful plan was adopted at the present meeting The subjects chosen for discussion on this occasion were "Fluctuations in the Age Classes of Fishes," and "Current Measurements, Direct and Indirect" No fewer than twenty communications were read on the former subject, and as there was no time for discussion it was arranged that the papers should be published and debated at the next meeting of the Council The same procedure was adopted for the papers read on current measurements

On Tuesday and Wednesday, April 16 and 17, a joint meeting of the International Council and the Challenger Society was held at the Laboratory of the Marine Biological Association at Plymouth Scientific exhibits were arranged by the staff of the Laboratory on the Tuesday, and on the following morning a discussion took place on the subjects considered at the special scientific meetings of last year, namely, "The Estimation of Phosphates and Nitrogenous Compounds in Sea Water" and "Racial Investigations of Fish" (see *Rapports et Procès Verbaux*, vols 53 and 54, 1929) Prof H H Gran described the results of his work on diatom frequency in relation to phosphates and nitrates He finds that while these salts decrease in proportion with increased frequency of diatoms, there are indications of some other unknown factor also at work Dr W R G Atkins remarked on the necessity for observing the greatest caution in estimating phosphates, as the slightest trace of impurities renders the samples useless

The discussion on races in fish was then opened by Prof E Ehrenbaum In the discussion which followed, the majority of the speakers inclined to the view that the counting of variable characters such as vertebræ, etc, is more likely to show up the effect of local conditions than to demonstrate the existence of distinct races Prof J Hjort proposed that the meeting should send a message to Prof F Heincke as a mark of respect for the great work he originated, many years ago, on the races of herring

Meteorology in India

We have received the first three volumes of a new series of meteorological publications that is being issued by the India Meteorological Department, entitled "Scientific Notes" We suppose that this publication will correspond with the "Professional Notes" of the Meteorological Office, London and if this be the case it will be valuable in that it will place on permanent record contributions to meteorology which, though not always of the first rank in importance, afford collectively a useful body of information, the reliability of which is to some extent vouched for by the issuing authority—in the case of the series under review, presumably the Director General of Observatories in India The only serious drawback of publications of this kind, as compared with similar papers read before a scientific society, appears to be that no discussion of the validity of the conclusions is published with them and the general reader can form little idea, in those cases where novel views are brought forward, as to whether or no a definite advance has been made

The first 'note' is by Mohammad Ishaque It is entitled "A Comparison of Upper and Gradient Winds at Agra and Bangalore" Here no novel opinions are put forward, but an unfortunate mistake in the statement of the motion of winds under balanced forces has been made in the introduction —a mistake that would immediately have been pointed out had the paper been read before a scientific audience—namely, that the ordinary 'gradient wind' equation does not hold at the equator, and therefore that the fairly good agreement found in temperate latitudes between the gradient wind and the actual wind at a height of 500 metres can scarcely be expected to hold in such a low latitude as that of Agra (27° N) or at Bangalore (13° N) This is no mere verbal slip, the author did not mean 'geostrophic' wind instead of 'gradient' wind, for he states that in determining his theoretical 'balanced' wind the curvature of the isobars was taken into account

Mr Ishaque's results show an astonishingly poor agreement between the computed and observed winds at Agra the correlation coefficient is only 0 34 for a height of 500 metres, and 0 39 for 1000 metres Sir Napier Shaw in his "Manual of Meteorology" quotes coefficients of about 0 7 and 0 8 for observations made in England To an uncritical reader, noting these contradictory results and observing that the Indian meteorologist was careful to deal only with days on which the pressure gradient was apparently determinable, an important fact would appear to have been established, but when it is pointed out that in England, where the difficulties in the way of obtaining a close network of reliable observations of barometric pressure must be less than in India, determination of the pressure gradient, and from it the 'gradient wind,' is impossible to do accurately, one is tempted to wonder whether the relative magnitude of the correlation coefficients in the two countries are not a measure simply of the point to which accuracy of measurement of barometric pressure has been carried in each case

The second and third 'notes' are useful contributions of a straightforward kind, dealing respectively with the hourly rainfall of Madras over a long series of years and with an interesting type of thunderstorm—the 'nor'wester' of South Bengal The nor'wester appears to be a thunderstorm of the line squall type which yields hailstones of a size fortunately seldom encountered in Europe, but the maximum wind speeds are more comparable with those of the European line squall and rarely exceed 50 miles an hour The storms are most frequent in April and May

University and Educational Intelligence

CAMBRIDGE —The Adams Prize for 1927–28 has been awarded to Prof Sydney Chapman, professor of mathematics in the Imperial College of Science and Technology, London The value of the prize is about £246 The subject set was "The Variations in the Earth's Magnetic Field in Relation to Electric Phenomena in the Upper Atmosphere and on the Earth"

DR R P RAUP, professor of the philosophy of education in Teachers College, Columbia University, New York City, will deliver a lecture on May 8 at 6 P M, on "The Psychological Basis of the 'Project Method,'" in the Library of the Central Hall, Westminster, S W 1 Tickets (price 1s) can be obtained from the secretary, New Education Fellowship, 11 Tavistock Square, W C 1

A SUMMER tour to Norway, leaving Newcastle on July 27, is being arranged by the Educational Travel Association Shore excursions under competent guidance will be made for studies in the fiord region, and an extension overland will be made to the sub arctic area of the tableland and to Oslo for the ethnological exhibits of Eskimo life collected by Amundsen, and the geological, botanical, and archæological collections there Particulars may be obtained by sending a 2d stamp to the honorary secretary, E T A, c/o the Cheshire Training College, Crewe

A SUMMER school of biology under the direction of Prof F A E Crew, is being organised by the Education Committee for the County Borough of Brighton, to be held at the Municipal Training College on Aug 2–16 Courses will be given on biology and the school curriculum (Prof A D Peacock, University of St Andrews, and Mr G B Walsh, High School for Boys Scarborough), on the theory of the cell, the gene, and organic inheritance in man (Prof F A E Crew), and there will be single lectures on special topics Practical and field work is being arranged Particulars can be obtained from the secretary to the Brighton Education Committee, Mr F H Toyne 54 Old Steine, Brighton

PARTICULARS of vacation courses to be held in Great Britain in 1929 are given in a pamphlet recently issued by the Board of Education There will be courses in science subjects in England and Wales as follows arranged by the Board for teachers only in physics at Cambridge and Harrow, in chemistry at Oxford, in biology at Cambridge, in engineering at Oxford, and in gas technology at Leeds, arranged by local education authorities—in chemistry at Nantwich, in biology at Brighton, Nantwich, and Bingley, in rural science at Barry (South Wales), in mining and engineering at Swansea, and in regional survey at Folkestone, organised by university bodies —in biology at Cambridge, Great Ayton (Yorks), and at or near Birmingham, in psychology at Cambridge, Oxford, Bristol, Rocester (Staffs), Chester, Bangor, and Harlech, organised by other bodies—in mine survey and economic geology at Camborne, in regional survey at Stratford on Avon, and in psychology of handwork at Chester A novel course in mothercraft, organised by the Board for teachers in elementary schools, will be held in London on July 22–Aug 2 Only three courses for foreigners are announced, to be held at Cambridge, London, and at Exeter The Board has this year, for the first time, included in the pamphlet particulars of vacation courses in Scotland, namely, courses for teachers arranged by the National Committee for the Training of Teachers, and courses, planned to be completed in two summers, of the ordinary university degree standard, to be held at Edinburgh in mathematics, physics, geography, and biology

Calendar of Patent Records.

May 6, 1845 —The introduction of the electric telegraph and its rapid progress were mainly due to the united efforts of Sir Charles Wheatstone and Sir William Fothergill Cooke, who, approaching the subject one from the scientific and the other from the business point of view, were brought together at a time when many attempts were being made to devise a practical system Their first patent was taken out in 1837 But complete success was not achieved until they produced the single needle telegraph, which was patented by them on May 6, 1845 A special Act of Parliament was passed to permit the formation of a company of more than twelve persons (the maximum number allowed under the various grants) to work this and all the earlier patents of the two inventors

May 7, 1794 —The first real gas engine was the invention of Robert Street, who patented it on May 7, 1794, under the title "A new invented method to produce an inflammable vapour force by means of liquid, air, fire, and flame, for communicating motion to engines and machinery" In Street's engine, a few drops of spirit of turpentine are introduced into the cylinder the bottom of which is kept heated so that the spirit is instantly converted into vapour The piston is at the same time moved upwards, and a quantity of air thereby sucked into the cylinder, which mixes with the vapour and forms an explosive mixture which is ignited by a flame applied to a touch hole

May 7, 1802 —The corkscrew now in common use in which the prong is fixed to the end of a right handed screw which works in a hollow quick left handed screw working in a hollow cylinder shaped to fit over the bottle mouth, so that the cork is pierced and extracted by one continuous right handed turning of the handle, was patented by Sir Edward Thomason of Birmingham on May 7, 1802 During the term of the patent more than 130,000 corkscrews of this type were made at prices ranging from one guinea to four shillings

May 9, 1807 —Sir William Cubitt's invention for automatically varying the area of sail in a windmill according to the strength of the wind was patented on May 9, 1807 Cubitt substituted movable shutters for the sail fabric, and geared the shutters to a rod running through the centre of the wind shaft, so that the opening and closing movements of the shutters were communicated to the rod A hanging weight attached to the end of the rod was adjusted to keep the shutters at the most suitable angle, but allowed them to open to present less effective surface to the wind when this became stronger than normal This mechanism and the earlier invention of Andrew Meikle for automatically keeping the sails into the wind were extensively adopted and are still in use in England, but were not taken up on the Continent

May 9, 1865 —The first application of hydraulic power for the operation of tools was Ralph Hart Tweddell's invention for fixing or tightening the ends of boiler tubes by means of expanding dies operated by hydraulic or other fluid pressure, which was patented on May 9, 1865 The invention was immediately successful and resulted in a reduction of more than one fourth in the cost of riveting

May 10, 1837 —The manufacture of galvanised iron is due to two Frenchmen, Ledru and Sorel, of Paris, who were granted a French patent for their invention on May 10, 1837, and followed this with twenty three patents of improvement between that date and 1846 The English patent was sealed in the name of Craufurd in April 1837

Societies and Academies.

LONDON

Royal Meteorological Society, April 17.—The late **W. H. Dines** and **L. H. G. Dines**: Monthly mean values of radiation from various parts of the sky at Benson, Oxfordshire. Records for the five years 1922–1926 are given. The radiation is dealt with under two heads: (1) Luminous rays; (2) dark heat rays of wave length exceeding about 2 μ; each is measured under conditions of (1) clear skies, (2) completely overcast skies.—**L. H. G. Dines**: An analysis of the changes of temperature with height in the stratosphere over the British Isles. The average temperature distribution in the stratosphere over the British Isles consists of a pronounced inversion of 3° C. at the bottom, followed by a lapse of about 0·5° C. per km. from (H_c+3) km. upwards to at least (H_c+8). There is no significant connexion between the magnitude of the inversion and either the lapse rate just below it, or the temperature in the troposphere in the layer $3\frac{1}{2}$ to $7\frac{1}{2}$ km. Such evidence as is available is against the existence of a diurnal variation of temperature in the stratosphere.—**H. A. Hunt**: A basis for seasonal forecasting in Australia. A fairly definite four year cycle is indicated, consisting of two dry years followed by two wet years, and requiring two years to be allotted to the drying and heating phase and two to the wetting and cooling. The four year period in the rainfall is also fairly well marked in the percentage of the continental area over which the rainfall is above the average each year.

PARIS

Academy of Sciences, Mar. 25.—**P. Villard**: Associations and forms of clouds. Discussion of the relations between the forms of clouds and production of rain.—**F. E. Fournier**: A means of extending French trade.—**Alex Véronnet**: There are three distinct spaces and three only: Euclid, Riemann, and Cartan.—**R. Chambaud**: The deformation of arches.—**J. H. Coblyn**: Diagrams and monograms.—**H. Weiss** and **E. Vellinger**: The measurement of the interfacial tension between mineral oils and aqueous solutions. The influence of time and of the hydrogen ion concentration. The interfacial tension of a system mineral oil–aqueous solution of electrolyte depends not only on the hydrogen ion concentration of the aqueous phase but also on the nature of the electrolytes utilised. But the variations due to the nature of the electrolytes are negligible as a first approximation compared with those brought about by the variations of the hydrogen ion concentration.—**F. Prevet**: The influence of boric acid on the phosphorescence of zinc sulphides prepared by the explosion method. The phosphorescent zinc sulphide prepared with boric acid is unaffected by air and moisture. There is a marked increase in the luminosity of the product.—**Pierre Leroux**: Study of the absorption of a specimen of blue rock salt. A study of the variation of the absorption of blue rock salt as a function of the wave length and of the temperature.—**Jean Cabannes** and **Pierre Salvaire**: The enlargement and displacement of the lines of the spectrum by molecular diffusion.—**M. Ponte**: Electronic analysis: lattice of the oxides of magnesium, zinc, and cadmium. The experimental results given permit of the conclusion being drawn that for the velocities of electrons utilised, electronic analysis is at least as accurate as analysis by X-rays, and may be used with confidence.—**E. Sevin**: The photoelectric effect and the continuous X-spectrum.—**André Michel** and **Pierre Benazet**: The reheating of austenitic steels.—**Léon Lortie**: The combinations of the salts of tetravalent cerium and of thorium with sodium carbonate (sodium cericarbonate and thoricarbonate). The ceric salt $Na_6Ce(CO_3)_5+12H_2O$ has been isolated in crystals. A thorium salt of analogous composition has also been isolated.—**L. Jacqué**: The fusibility of the ferro-calcium alloys.—**R. Cornubert** and **Ch. Borrel**: Anomalies of condensation and of cyclisation. Studies on the condensation products of α-methyl-α'-cyclopentanone and benzaldehyde in the presence of hydrochloric acid.—**J. Bougault** and **Mlle. Bl. Leroy**: Phenyloxymaloic anhydride. This substance gives crystallised compounds with amines, insoluble in ether: useful for the characterisation of the amines.—**A. Demay**: The antestephanian tectonic of the central French plateau to the east of the Loire.—**René Bréon**: Observations on beach deposits. In the bay of Authie pebbles and fragments of rocks are found which appear to have been transported at least 250–300 kilometres from the coast of the south of England. It is impossible for these to have been carried in suspension like sand, and the question as to the means of transportation is difficult of solution. One single specimen of rock had attached to it remains of *Fucus saccharinus*, and the author suggests that seaweed attached to the rocks may have been the cause of the flotation.—**A. Vincent**: The electrification of winds charged with snow. Winds charged with frozen snow caused the development of high potentials in an aerial capable of giving sparks up to 5 mm. in length.—**Joseph Devaux**: The measurement of the absorption factor of the surface of some Pyrenees glaciers for the solar radiations. If the surface of the glaciers consisted of pure ice limited by a plane surface, about 98 per cent would be absorbed. The absorption factors found were between 0·4 and 0·77, the lower value being undoubtedly due to the extensive alterations in the surface of the glaciers.—**I. D. Streinikov**: The ecological conditions of existence of the fauna of the Kara Sea.—**C. Chabrolin**: The decay of the inflorescence of the date palm (Khamedj). The author confirms the conclusions of Cavara that this disease is due to the parasite *Manginiella Scættæ*. The most practical treatment appears to be dusting the terminal bud with a mixture of powdered copper sulphate and slaked lime.—**Jules Amar**: Sex and nutrition.—**Serge Yourlevitch**: The principal characters of the ocular movements. A summary of the results of a kinematographic study of more than 20,000 movements of the eye.—**Jacques Pellegrin**: The Cichlidæ of Madagascar.—**E. Voisenet**: New researches on the nature of the substance which produces the bitter taste in the disease of bitter wines. A description of the isolation of a very bitter substance, a derivative of acrolein, from 40 litres of wine attacked by the disease.—**H. Colin** and **Marc Simonet**: The viscous fermentation of the frozen beet. The viscous material is produced by a coccus at the expense of the sugar. The coccus has been isolated and cultivated. The viscous material appears to be identical with the dextrane previously isolated by various authors from sugar refinery juice contaminated with *Leuconostoc mesenteroides*.—**Ducloux**, **Rinjard**, and **Mlle. Cordier**: The symbiosis *in vivo* of the virus of Borrel's pustule in sheep and the virus of foot and mouth disease.

April 2.—**A. Lacroix**: A meteorite which fell at Beyrout (Syria) on Dec. 31, 1921.—**L. Léger** and **O. Duboscq**: *Harpella melusinæ*, an eccriniform entophyte parasite of the larvæ of *Simulium*.—**J. A. Schouten**: The geometrical significance of the semi-symmetrical property of an integral connexion which leaves the fundamental tensor invariant.—**C. Bonnier**: The determination of the

temperatures in explosion motors —Georges Mignonac and René Vanier de Saint-Aunay The polymerisation of acetylene by the silent discharge The synthesis of dipropargyl and of its isomers The complicated mixture produced by the action of the silent discharge on acetylene consists partly of a primary condensation product due to the discharge alone and partly of the secondary polymerisation of this by heat By carrying out the reaction at 60° C the hydrocarbons dipropargyl, methylpentadiine and a hexadiene were isolated —Pierre Bedos and Adrien Ruyer The dehydration of the oxide of cyclohexene and the passage from the C_6 ring to the C_5 ring Cyclohexene oxide can be dehydrated by phthalic anhydride giving 1 3 cyclohexadiene and this is generally accompanied with isomerisation of the oxide to cyclopentane aldehyde —Paul Lemoine The superposition of a Tertiary anticline on a Cretaceous syncline

BRUSSELS

Royal Academy of Belgium June 2 G Cesaro The points of equal inertia of the rhombohedron Victor Willem The polarity of the locomotor apparatus of the actinians Th De Donder The photonic field Ad Mineur Left projective cubics L Van den Berghe Researches on deglutition in the teleostean fishes Frans Halet The discovery of an eruptive mass in the subsoil of Grammont —L Godeaux The congruences formed by the Wilczynski lines of a surface L Godeaux The surfaces having the same quadrics of Lie —G Van Lenberghe The calculation of the fugacities of a solution R H J Germay The formula of Lagrange and its generalisation by M T J Stieltjes

Aug 4 A de Hemptinne The ionisation and chemical combination of gases Lucien Godeaux The congruences of Goursat and surfaces having the same Lie quadrics —J Jaumotte E Lahay and J F Cox An apparatus for the measurement of the magnetic inclination intended to be utilised by an aviator to determine his latitude The measurement is based on the electromotive force developed by a rotating coil a null method being adopted in which the galvanometer unsuitable for an aeroplane, is replaced by a telephone An accuracy of 10 is indicated as possible fixing the position in latitude within about 20 kilometres —P Teilhard de Chardin Complementary note on the mammalian fauna of the lower Tertiary of Orsmael —M D V Jonesco A theorem of Lord Kelvin

CRACOW

Academy of Science and Letters Jan 7 — T Banachiewicz Auxiliary tables for the calculation of the selenographic co ordinates —T Banachiewicz New methods for the correction of orbits —W Lesniański A method for the synthesis of acridone derivatives The use of phosphorus oxychloride as the condensing agent in the transformation of arylamine carboxylic acids into derivatives of acridone is advantageous good yields being obtained Mlle E Majdecka-Zdziarska *Galinsoga parviflora* and *Galinsoga hispida* A discussion of the geographical distribution of these American species in Europe and in Poland, and of the question whether these should be considered as varieties or distinct species Mlle C de Kleist Phyto sociological researches on the peat bogs of the region of the dunes of the right bank of the Vistula in the neighbourhood of Warsaw —S Macko Researches on the geographical distribution and the biology of *Azalea pontica* in Poland —W Szafer The element peculiar to the mountains in the flora of the Polish plain The geographical distribution of mountain plants in the plain leads to conclusions relating to the history of the migration of the plants during the diluvial period —M Thomaschewski Pollen analysis of the peat bogs of Kalmuzy and Pomorania —Z Woycicki The crystalloids in the nucleus and in the formations known as oleoplasts in *Ornithogalum caudatum* —R J Wojtusiak Comparative studies of the larvæ of the genus *Mamestra* — S Karasinski Researches on the action of the antirachitic vitamin Rickets should be considered as a trouble of development due to a complicated avitaminosis which can only be partly suppressed by the antirachitic factor

Feb 4 E Zylinski A theorem of the theory of algebraic numbers L Marchlewski and O Wyrobek The absorption of the ultra violet radiations by certain organic substances L Marchlewski and A Szymanski Researches on chlorophyll P Mazák and J Susko Researches on the oxosulphonic acids K Dziewonski and A Wulffsohn Researches on β methylnaphthaline B Hryniewiecki The geographical distribution of *Trapa* in Poland and contribution to the study of the varieties of this species —T Wisniewski Associations of Bryophyta of Poland and especially of those of the virgin forest of Bialowieza — R Kobendza The flora of the fallen ground in the massif of Ste Croix B F Petschenko New and little known forms in the development of *Bacillus megatherium* and their cytology St Smreczynski — Experimental researches on gastrulation in the batrachians —R J Wojtusiak The orientation in space of the caterpillars of *Pieris* W Heinrich The function of the capillaries and the fixation of the attention

LENINGRAD

Academy of Sciences (*Comptes rendus* No 24 1928) S Borovik and Afanasjeva Influence of a vacuum on the radium clock Some improvements in the Strutt radium clock are offered and a method of making exact measurements with it of the pressure in relative vacua A Lukašuk Helium in some thorium minerals of Russia The quantity of helium found in four minerals examined was as follows chevkinite 0 109 c c eshinite 0 648 c c ortite 0 0638 c c monatsit 0 287 c c in one gram of the mineral P Svetlov Osmotic pressure and the permeability of membranes of trout eggs External membrane is permeable to electrolytes organic molecules and colloid particles Osmotic pressure in the yolk of the eggs is constant throughout the period of development so that some unknown mechanism for the regulation of the pressure must be present B Stegmann A preliminary communication on an ornithological expedition in the upper and middle course of the Amur and in the western part of the Stanovoi ridge Notes on distribution nesting habits etc of a number of local bird species C Flerov Preliminary note on the diagnostic characters in the genus *Moschus* Linn (Mammalia, Cervidæ) A brief review of musk deers containing diagnoses of five subspecies of *Moschus moschiferus* (including two new ones namely, *arcticus*, from north east Siberia and *sachalinensis* from Sakhalin Island) two subspecies of *M chrysogaster* and of a new species *M berezovskii*, from the Sze chuan province of China

(*Comptes rendus* No 25, 1928) B Schtylko Fossil remains of a pike from the Akmolinsk province The remains are those of a *dentale*, and their study showed no differences from the *Esox lucius*, and it may be suggested that the latter species existed already in the Pleistocene A Mordvilko *Geoica* Hart and its anolocyclic forms Plant lice of the genus *Pemphigetum* Mordv, forming galls on *Pistachia* trees proved to be able to migrate to roots of grasses, where they have been long known under the name

Geoica The *Geoica* root form occurs in the areas where there are no *Pistachia* at present (North America), but it is possible to state definitely that the trees grew there in previous geological ages, with their disappearance only the grass root form of the aphid remained —**G Lindberg** Southern elements in the fish fauna of the Bay of Peter the Great (Sea of Japan) The fauna differs strikingly from that of the Okhotsk and the Bering Seas in its subtropical character, while including a number of typical Arctic forms, many of which, however, penetrate as far south as the Korean coasts At the same time, a number of southern forms are in their turn met with as far north as Vladivostok and Olga Bay

Melbourne

Royal Society of Victoria, Dec 13 **Edwin S Hills** The geology and palæontology of the Cathedral Range and the Blue Hills, in North Western Gippsland This range is a double razorback composed of two beds of hard sandstone separated by softer shales and sandstones Although formerly believed to be Upper Palæozoic in age, they are overlain with a strong unconformity by Upper Devonian rhyolites, basalts, tuffs and sediments outcropping to the east and are apparently conformable with Upper Silurian sediments which outcrop to the west The Cathedral Beds have as yet yielded no fossils, but in the Upper Devonian rocks a new fish fauna was discovered —**F Chapman** (1) On a fine example of the flanged cowrie *Cypræa gastroplax* McCoy The subgenus *Palliocypræa* to which the species was referred by M Cossmann is here given generic rank The shell structure is discussed —(2) On some trilobites and brachiopods from the Mount Isa District North West Queensland For many years these beds were referred to as schists of unknown age The rock in which the fossils are preserved is a cherty shale, horizontally bedded and found twelve miles west of Mount Isa at the head of the Templeton River The assemblage of fossils indicates a middle to upper Cambrian horizon —(3) On a new species of *Capulus* found attached to a *Pterygotus* carapace Some attached univalves, *Capulus melbournensis*, adherent to the counterpart of the Silurian *Pterygotus* somite which was described by McCoy in 1899 This palæozoic *Capulus* shows, in its habit and form, a close resemblance to the related tertiary genus *Hipponix*

Vienna

Academy of Sciences, Jan 31 —**E Haschek** On Talbot's Law **M Eisler** and **L Portheim** Further researches on the nicotine poisoning of fruits and seeds In *Nicotiana* and *Avena*, the alkaloid penetrates unhindered through the husk, in *Fagopyrum* with difficulty in *Helianthus* scarcely at all The embryos are unequally resistant to nicotine Calcium and potassium chlorides influence the degree of poisoning —**L Mirskaja** Regenerative processes in growing points of *Tradescantia guianensis* —**M Holly** Some new African fish forms Species of *Barbus* from rivers

Feb 8 —**R Wegscheider** Reactions in light and in the dark with counter and following effects —**L Moser** and **A Brukl** Determination and separation of rare metals from other metals (15) The quantitative analysis of gallium For separation of little gallium from much iron, sodium thiosulphate was used, this reduces ferric to ferrous and precipitates gallium —**F Staudinger** Heteromorphoses in stigmata and other organs of *Carausius morosus* —**H Burchardt** Regeneration and symmetry of limbs stuck through the bodies of newts —**C Zawisch-Ossenitz** The promotion of bone growth by injection of bone extract

Feb 14 —**A Kailan** and **G Brunner** Velocity of esterification of alcohols in formic acid —**O Gugenberger** The Brachiopoda of the Cardita strata at Launsdorf in Middle Carinthia —**O Gugenberger** Upper Triassic Cephalopoda and Brachiopoda from Plakles on the Hohe Wand —**R E Mark** Researches on the influence of various altitudes on the action of the thyroid gland in the dog —**K Federhofer** Graphical kinematics of a crank loop oscillating in space

Official Publications Received

British

Royal Photographic Society of Great Britain. List of Honorary Fellows, Honorary Members Fellows Associates and Members, 1929 Pp 81 (London) 1s

Philosophical Transactions of the Royal Society of London Series B, Vol 217 No 446 Chromosome Linkage in certain Oenothera Hybrids By Prof R Ruggles Gates and F M L Sheffield Pp 367 394 + plates 89-90 (London Harrison and Sons Ltd)

Proceedings of the Royal Society of Queensland Vol 40, No 1 Presidential Address. By Prof. E J Goddard Pp 12. (Brisbane Anthony James Cumming)

Memoirs of the Department of Agriculture in India Botanical Series Vol 17 No 1 Non-dehiscence of Anthers in Punjab American Cottons By Trevor Trought. Pp 5+2 plates. (Calcutta Government of India Central Publication Branch.) 4 annas 5d

Memoirs of the Commonwealth Solar Observatory Mount Stromlo Canberra, Australia. Memoir No 1 The Luminosity of the Night Sky observed with a Rayleigh Photometer at the Commonwealth Solar Observatory during the Years 1926 and 1927 by the Director and Staff Pp 20 (Melbourne H J Green)

The Scientific Proceedings of the Royal Dublin Society Vol 19 (N S) No 16 The Integration of Light by Photo electrolysis By Dr W R G Atkins and Dr H H Poole Pp 159 164 6d. Vol 19 (N S), No 18 The Photo electric Measurement of the Illumination in Buildings By Dr W R G Atkins and Dr H H Poole Pp 173 188 1s (Dublin Hodges Figgis and Co London Williams and Norgate, Ltd)

Air Ministry Aeronautical Research Committee Reports and Memoranda. No 1205 (Ae 360) Full Scale Tests of Bristol Fighter Aeroplane with R A F 30 Wings fitted with Pilot Planes at the Wing Tips (T 2666.) Pp 4+2 plates 4d. net. No 1173 (Ae. 337) Full Scale Determination of the Effect of High Tip Speeds on the Performance of an Airscrew By W G Jennings. (T 2655) Pp 10+8 plates 9d net (London H M Stationery Office)

Commission of Inquiry into the Holborn Explosions and Fires Report of the Commissioners appointed by the Home Secretary to inquire into the Circumstances of the Series of Explosions and Fires which occurred on the 20th and 21st December 1928 in the neighbourhood of New Oxford Street (Cmd 3306) Pp 54+4 plates (London H M Stationery Office) 1s 6d net

Third Report of the Committee appointed by Viscount Peel to consider the Establishment of Bird Sanctuaries in the Royal Parks in Scotland Pp 6 (Edinburgh and London H M Stationery Office) 6d net

Nyasaland Protectorate Geological Survey Water Supply Paper No 3 Weirs Dams and Reservoirs for Estate Purposes By Dr F Dixey Pp 12 Annual Report of the Geological Survey Department for the Year 1928. Pp. 22 (Zomba)

Union of South Africa Department of Agriculture Division of Chemistry Series No 92 Manuring of Wattles by C O Williams and Fertilizer Trials with Wattles by J B Osborn Pp. 10 (Pretoria Government Printing Office.)

Colony and Protectorate of Kenya Agricultural Census Ninth Annual Report, 1928 Pp 55 (Nairobi Department of Agriculture)

Trinidad and Tobago Department of Agriculture. Administration Report of the Director of Agriculture for the Year 1927 Pp 42 (Trinidad B W I Government Printing Office Port-of-Spain) 1s 6d

Journal of the Royal Microscopical Society Series 3, Vol 49 Part 1 March Pp xvi+90 (London.) 10s net

Imperial Chemical Industries Ltd Annual Report for the Year 1928 Pp 18 (London)

Royal Astronomical Society List of Fellows and Associates March 1929 Pp. 54 (London)

Ministry of Health General Circular on the Local Government Act 1929 Pp 14 (London H M Stationery Office) 3d. net

Ministry of Health Advisory Committee on Water Report on Rural Water Supplies. Pp 38 (London H M Stationery Office) 9d net.

Air Ministry Aeronautical Research Committee Reports and Memoranda. No 1165 (Ae 329) Wind Tunnel Experiments on the Design of an Automatic Slot for R.A F 28 Section and on Interconnection with Ailerons By F B Bradfield and K. W Clark (T 2625 a.b c) Pp. 20+13 plates 1s net. No 1181 (Ae 345) Instrumental Records of the Lateral Motions of a Stalled Bristol Fighter Aeroplane By Prof B Melvill Jones and Flight-Lieut C E Maitland (T 2657) Pp 11+22 plates 1s net No 1186 (Ae 348) Wind Tunnel Tests of various Servo Rudder Systems By K V Wright (T 2680) Pp. 17+10 plates 1s. net No 1192 (Ae 354) Wind Tunnel Tests for Design of an Automatic Slot for Avro 504 N By E T Jones and K. W Clark (T 2633) Pp 11+5 plates 9d net. No 1193 (Ae 355) The Longitudinal Control of an Aeroplane beyond the Stall By H M Garner and K V Wright. (T 2727) Pp 6 4d. net. No. 1198 (Ae 359) Wind Tunnel Tests with High Tip Speed Airscrews The Characteristics of a Conventional Airscrew Section 0·082c Thick and of R A F 27 and R A F 28. By Dr G P Douglas and W G A Perring (T 2681) Pp 4+5 plates 1s net. No 1202 (Ae 363) Determination of the Twist of a Wing of an Aeroplane in Flight By W G Jennings (T 2666) Pp. 5+1 plate. 6d. net (London H M Stationery Office)

Proceedings of the Royal Society Series A, Vol 123, No A792, April 6 Pp. 373-786+plates 18-22 (London Harrison and Sons, Ltd) 12s

The Proceedings of the Physical Society Vol 41 Part 3, No 228, April 15 Pp iv+181-280 (London) 7s net.

Judicial Statistics England and Wales, 1927 Criminal Statistics Statistics relating to Criminal Proceedings Police, Coroners Prisons and Criminal Lunatics for the Year 1927 (Cmd 3301) Pp xxiii+13 229 (London H M Stationery Office) 4s net

Reports of the Council and Auditors of the Zoological Society of London for the Year 1928, prepared for the Annual General Meeting to be held at the Society's Offices in Regent's Park on Monday April 29th 1929 at 4 p.m Pp 87 (London)

Report of the Rugby School Natural History Society for the Year 1928 (Sixty second Issue) Pp 40+2 plates (Rugby)

Brackenhill Open Air Home School Hartfield near Tunbridge Wells Annual Report September 1927 to August 1928 Pp 18 (Hartfield)

Foreign

Proceedings of the American Academy of Arts and Sciences Vol 63 No 9 Thermo-electric Phenomena and Electrical Resistance in Single Metal Crystals By P W Bridgman Pp 351-399 90 cents Vol 63 No 10 The Effect of Pressure on the Rigidity of Steel and several varieties of Glass By P W Bridgman Pp 401-420 45 cents Vol 63 No 11 Tables of Lagrangean Coefficients for Interpolating without Differences By Edward V Huntington Pp 421-437 4 cents (Boston Mass)

Proceedings of the United States National Museum Vol 73 Art 15 Contribution to the Comparative Anatomy of the Eared and Earless Seals (Genera Zalophus and Phoca) By A Brazier Howell (No 2736) Pp 142+1 plate Vol 74 Art 14 New Fossil Mollusks from the Miocene of Virginia and North Carolina, with a Brief Outline of the Divisions of the Chesapeake Group By Wendell C Mansfield (No 2759) Pp 11+5 plates Vol 74 Art 23 Mineralogy and Geology of Cerro Mercado Durango Mexico By William F Foshag (No 2768) Pp 27+4 plates Vol 74 Art 26 The Gums of the Porpoise Phocoenoides Dalli (True) By Gerrit S Miller Jr (No 2771) Pp 4+4 plates (Washington D C Government Printing Office)

Department of Commerce Bureau of Standards Bureau of Standards Journal of Research Vol 2 No 2 February R.P No 38 A Technical Method of Using the Mercury Arc to obtain Data at Wave Length 560 mμ in the Spectrophotometric Analysis of Sugar Products by H H Peters and F P Phelps R P No 39 Reflecting Power of Beryllium Chromium and several other Metals by W W Coblentz and R Stair R P No 40 Note on a Piezo electric Generator for Audio frequencies by August Hund R P No 41 Heats of Combustion of Organic Compounds by M S Kharasch R P No 42 Laboratory Corrosion Tests of Mild Steel with special reference to Ship Plate by Henry S Rawdon R P No 43 Least Retinal Illumination by Spectral Light required to evoke the Blue Arcs of the Retina by Deane B Judd R P No 44 The Service of Refractory Blocks in a small Experimental Glass Tank by W L Pendergast and Herbert Insley Pp 335-465+10 plates (Washington, D C Government Printing Office)

Académie Tchèque des Sciences (Česká Akademie Věd a Umění) Bulletin International Résumés des travaux présentés Classe des Sciences mathématiques naturelles et de la médecine 27e année (1926) Pp x+678 (Prague)

Sveriges Geologiska Undersökning Ser Aa No 121 Beskrivning till kartbladet Skövde Av Henr Munthe A H Westergård och G Lundquist Pp 182+2 tavlor 4 00 kr Ser Aa No 158 Beskrivning till kartbladet Valdemarsvik Av R Sandegren och N Sundius Pp 70+1 tavla 4 00 kr Ser Aa, No 159 Beskrivning till kartbladet Gusum Av Bror Asklund Gunnar Ekstrom och Gunnar Assarsson Pp 107+1 tavla 4 00 kr Ser Aa, No 165 Beskrivning till kartbladet Filipstad Av Nils H Magnusson och Erik Granlund Pp 119+1 tavla 4 00 kr Ser Aa No 169 Beskrivning till kartbladet Silta Av Henr Munthe J Ernhold Hede och G Lundquist Pp. 130+1 tavla 4 00 kr (Stockholm)

Department of Commerce Bureau of Standards Bureau of Standards Journal of Research Vol 2 No 3 March R P 45 Apparatus and Methods for the Separation Identification and Determination of the Chemical Constituents of Petroleum by Edward Washburn Johannes H Bruun and Mildred M Hicks R P No 46 Recombination Spectra of Ions and Electrons in Cesium and Helium by F L Mohler and C Boeckner R P No 47 The Spectral Absorption of certain Monoazo Dyes I The Effect of Position Isomerism on the Spectral Absorption of Methyl Derivatives of Benzeneazophenol, by Wallace R Brode R P No 48 Transmission of Sound through Wall and Floor Structures by V L Chrisler and W F Snyder R P No 49 Discharge Coefficients of Square-edged Orifices for Measuring the Flow of Air by H S Bean E Buckingham and P S Murphy Pp 467-658+8 plates (Washington D C Government Printing Office)

Bulletins of the Pacific Scientific Fishery Research Station Vol 2 Part 3 Some Observations on the Spawning of the Amour and Kamchatka Salmons By I I Kusnetzow Pp 196 In Russian with Summary in English 3 rub 75 kop Vol 2 Part 4 Materials of the Land Flora of the Shantar Islands By I K Shishkin Pp 48 In Russian with Summary in English 75 kop. Vol 2 Part 5 Mammals of the Shantar Islands By Prof S I Ognew Pp 43 In Russian with Summary in English 60 kop (Vladivostock)

Proceedings of the Imperial Academy Vol. 5 No 2 February Pp iii iv+57-102. (Tokyo)

Japanese Journal of Astronomy and Geophysics Transactions and Abstracts Vol 6, No 2. Pp. 71-142+4 plates (Tokyo National Research Council of Japan)

Proceedings of the California Academy of Sciences Fourth Series Vol 18, No 4 Marine Miocene and related Deposits of North Colombia By Frank M Anderson Pp 73-213+plates 8-23. (San Francisco.)

Proceedings of the United States National Museum Vol 74 Art. 16 A Revision of the North American Ichneumon Flies of the Genus Mesostenus and related Genera By R. A. Cushman (No 2761) Pp. 58 Vol 75, Art. 7 A Revision of the American Two winged Flies of the Psychodid Subfamily Bruchomyinae By Charles P Alexander (No 2778) Pp. 9 (Washington D C Government Printing Office.)

List of Publications of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington 1928 Pp 9 (Washington D C Carnegie Institution)

Proceedings of the California Academy of Sciences. Fourth Series Vol 18 Nos 5 6 7, 8 No 5 A New Pecten from the San Diego Pliocene by Leo George Hertlein No. 6 A New Species of Land Snail from Kern County California, by G Dallas Hanna No 7 A New Species of Land Snail from Coahuila, Mexico by G Dallas Hanna and Leo George Hertlein No 8 Some Notes on Oreohelix, by Junius Henderson Pp 215-227+plate 24 Vol 18 No 9 Notes on the Northern Elephant Seal By M E McLellan Davidson Pp 229-243+plates 25-26 Vol 18 No 10 On a Small Collection of Birds from Torres Strait Islands and from Guadalcanar Island Solomon Group By M E McLellan Davidson Pp. 245-260 Vol 18 No 11 The Generic Relationships and Nomenclature of the California Sardine By Carl L Hubbs Pp 261-265 (San Francisco)

Department of the Interior Bureau of Education Bulletin 1928 No 23 Record of Current Educational Publications comprising Publications received by the Bureau of Education October-December 1927 with Index for the Year 1927 Pp 116 (Washington D C Government Printing Office) 20 cents

Catalogues.

Getting the Most out of Radio Pp 184 (Liverpool Claude Lyons Ltd)

Clarostat a Brief Survey of their Applications in the Science of Radio Third edition revised and enlarged Pp 24 (Liverpool Claude Lyons Ltd)

Concerning High Frequency Stabilisation by Piezo Electric Oscillators Pp 12 (London Adam Hilger Ltd)

Spectroscopy in Control of Purity in Food Stuffs Pp 7 (London Adam Hilger Ltd)

Diary of Societies

FRIDAY May 3

Iron and Steel Institute (Annual Meeting) (at Institution of Civil Engineers) at 10 a m —Announcement of the award of the Andrew Carnegie Research Scholarships for 1929 30 —Presentation of the Carnegie Gold Medal to Dr A Bramley—The Hon Sir Charles Parsons and H M Duncan A New Method for the Production of Sound Steel —Third Report on Heterogeneity of Steel Ingots by a Committee of the Institute —J M Robertson The Microstructure of Rapidly Cooled Steel —D Lewis The Transformation of Austenite into Martensite in a 0·8 per cent Carbon Steel —A L Norbury Constitutional Diagrams for Cast Irons and Quenched Steels —At 2 30 —G R Bolsover Brittleness in Mild Steel —J B Pfeil The Oxidation of Iron and Steel at High Temperatures —E G Herbert and P Whitaker The Differential Method for Measuring the Thickness of Hard Cases without Sectioning them —T E Rooney and G Barr A Method for the Estimation of Hydrogen in Steel

Royal Society of Medicine (Otology Section) (Annual General Meeting) at 10 30 a m —The Treatment of Chronic Deafness —Dr D McKenzie The Symptomatic Treatment of Deafness H Kisch Chronic Deafness Its Treatment and Prevention —T Neville Chronic Deafness —G S Hett and A G Wells Ionisation as a Treatment for Middle ear Suppuration

Royal Astronomical Society (Geophysical Discussion) at 4 30 —Cloud Formation C J P Cave Sir Gilbert Walker Chairman Sir Frank Dyson

Royal Society of Medicine (Laryngology Section) (Annual General Meeting) at 5 —F I Cleminson Treatment of Carcinoma of the Œsophagus by Radium

Philological Society (at University College) at 5 30 —Anniversary Meeting

Institution of Electrical Engineers (Meter and Instrument Section) at 7 —G D Malcolm Chairman's Address

Institution of Mechanical Engineers (Informal Meeting) at 7 —H Barry London's Water

Geologists' Association (at University College), at 7 30 —Dr S W Wooldridge and A. J Bull The Arun Gap and Lower Greensand around Pulborough

Institution of Automobile Engineers (jointly with Institution of Production Engineers) (at Royal Society of Arts) at 7 45 —H F J Orcutt The Production and Application of Ground Gears (Lecture)

Royal Society of Medicine (Anæsthetics Section) (Annual General Meeting), at 8.30 —Dr H Sington Pre medication by Paraldehyde in Children

Royal Institution of Great Britain at 9 —Sir Daniel Hall The Garden Tulip

SATURDAY, May 4

Institution of Municipal and County Engineers (Eastern District) (at Red Lion Hotel, Cromer) at 1

Institution of Municipal and County Engineers (South Eastern District) (at Aerodrome Hotel Croydon), at 2 15 —G A Ballard Town Planning and Municipal Airports.

MONDAY May 6

Cambridge Philosophical Society (in Botany School) at 4 30 —A H K Petrie On the Ionic Equilibria of Plant Tissues.—R. G Tomkins Mould Growth and Atmospheric Humidity —R. D Whyte The Cytological Basis of Partial Dioecism in Plants.—*Papers to be communicated by title only* —C Pellew The Genetics of Unlike Reciprocal Hybrids —A. R Shull Determination of Types of Individuals in Aphids, Rotifers and Cladocera.—J A Bierens de Haan Animal Language and its Relation to that of Man —G Koller Internal Secretions in Invertebrate Animals

ROYAL SOCIETY OF EDINBURGH at 4 30 — G N Hunter Colour Sensitivity — Dr E B Ludlam and R B Mooney The Influence of Air and Moisture on the Budde Effect in Bromine — A C Stephen Studies on the Scottish Marine Fauna The Fauna of the Sandy and Muddy Areas of the Tidal Zone — George Redington Study of the Effect of Diurnal Periodicity upon Plant Growth — Dr Margery Knight Studies in the Ectocarpaceæ II Life History and Cytology of *Ectocarpus siliculosus* Dillw — *to be read by title only* — Miss Mary H Latham Jurassic and Kainozoic Corals from Somaliland — Dr S Goldstein On the Asymptotic Expansion of the Characteristic Numbers of the Mathieu Equation

VICTORIA INSTITUTE (at Central Buildings Westminster), at 4 30 — Rev Canon A Lukyn Williams Early Anti Judaica—the Books of Testimonies

ROYAL GEOGRAPHICAL SOCIETY (at Lowther Lodge), at 5 — Dr G C Simpson The Importance of Climatic Stations in Polar Regions

ROYAL INSTITUTION OF GREAT BRITAIN at 5 — General Meeting

BRITISH PSYCHOLOGICAL SOCIETY (Education Section) (at London Day Training College) at 6 — Dr R B Raup Is there a Psychology for Modern Education?

RAILWAY CLUB (at 57 Fetter Lane) at 7 30 — D D Battie A Thirty Years Survey

ROYAL SOCIETY OF ARTS, at 8 — Sir E Denison Ross Nomadic Movements in Asia (Cantor Lectures) (IV)

SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Chemical Society) at 8 — Dr T Moran Recent Advances in the Low temperature Preservation of Foodstuffs

SURVEYORS INSTITUTION at 8 — H F Bidder and W V Graham Rights in Underground Water

TUESDAY, MAY 7

ROYAL SOCIETY OF MEDICINE (Orthopedics Section) at 5 30 — Annual General Meeting

ZOOLOGICAL SOCIETY OF LONDON at 5 30 — Major S S Flower Exhibition of the Centenary Edition of the Vertebrate List Vol I, Mammals — F Martin Duncan Exhibition of Cinematograph Films of North American Big Game presented to the Society by Mr Prentiss N Gray — E B Worthington New Species of Fish from the Albert Nyanza and Lake Kioga — W Rowan A Hermaphrodite Spiny Dogfish (*Squalus sucklei*)

LONDON NATURAL HISTORY SOCIETY (at Winchester House E C) at 6 30 — T J Evans Life in the Deep Sea

INSTITUTE OF MARINE ENGINEERS at 6 30 — W J Muller Notes on the Lentz Standard Marine Engine as Fitted to Ships of the Koninklijke Paketvaart Maatschappij (Royal Packet Line) Amsterdam

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group) at 7

INSTITUTE OF METALS (at Institution of Mechanical Engineers) at 8 — Sir Oliver Lodge Some Ideas about Metals (Annual May Lecture)

TELEVISION SOCIETY (at Engineers Club Coventry Street) at 8 — Capt R Wilson and A A Waters Some Practical Considerations in the Building of Television Apparatus — Demonstrations Model Showing Mechanical Exploring as the Speed of the Disc Increases from Zero R R Poole — Model of Talking Film Projector H S Ryland

WEDNESDAY MAY 8

ROYAL SOCIETY OF MEDICINE (Surgery Sub Section of Proctology) (Annual General Meeting) at 4 45 — At 5 — Discussion on Fistula in ano

GEOLOGICAL SOCIETY OF LONDON at 5 30 — F M Trotter The Glaciation of Eastern Edenside the Alston Block and the Carlisle Plain — J A Douglas A Marine Triassic Fauna from Eastern Persia.

ROYAL SOCIETY OF ARTS at 8.

ELECTROPLATERS AND DEPOSITORS TECHNICAL SOCIETY (at Northampton Polytechnic Institute) at 8 15 — Dr H O Cocks Some Possible Uses of Alternating Currents in Electrodeposition

INSTITUTION OF CHEMICAL ENGINEERS (Jointly with Institute of Fuel) — Discussion on The Scope of the Chemical Engineer in Relation to the Fuel Consuming Industries

THURSDAY MAY 9

ROYAL SOCIETY, at 4 30 — R H Fowler and Dr P Kapitza Magnetostriction and the Phenomena of the Curie Point — Prof C G Darwin A Collision Problem in the Wave Mechanics — J A Gaunt The Relativistic Theory of an Atom with many Electrons — R de L Kronig The Quantum Theory of Dispersion in Metallic Conductors — *Papers to be read by title only* — F J Wilkins The Kinetics of the Oxidation of Copper Part I — C E Eddy Prof T H Laby and A H Turner Analysis by X Ray Spectroscopy — M C Johnson The Adsorption of Hydrogen on the Surface of an Electrodeless Discharge Tube — A Elliott The Absorption Band Spectrum of Chlorine — H W Thompson and C N Hinshelwood The Influence of Nitrogen Peroxide on the Combination of Hydrogen and Oxygen — H J Phelps and R A Peters The Influence of Hydrogen Ion Concentration on the Absorption of Weak Electrolytes by Pure Charcoals — Dr H T Flint The First and Second Order Equations of the Quantum Theory — S Bhagavantam The Magnetic Anisotropy of Naphthalene Crystals — A H Wilson Perturbation Theory in Quantum Mechanics II — C G Lyons and Dr E K Rideal On the Stability of Unimolecular Films Parts I II and III — P A M Dirac Quantum Mechanics of Many Electron Systems — Prof O W Richardson and P M Davidson The Spectrum of H_2. The Bands Analogous to the Parhelium Line Spectrum Parts III and IV — H E Hurst The Suspension of Sand in Water — D Brunt The Transfer of Heat by Radiation and Turbulence in the Lower Atmosphere — R K Asundi The Third Positive Carbon and Associated Bands — Prof G I Taylor The Criterion for Turbulence in Curved Pipes — W G Bickley Hydrodynamic Forces acting on a Cylinder in Motion, and the Idea of a Hydrodynamic Centre — M L E Oliphant The Action of Metastable Atoms of Helium on a Metal Surface — J Hargreaves The Effect of a Nuclear Spin on the Optical Spectra — Prof M N Saha and Ramesh Chandra New Methods in Statistical Mechanics — N F Mott The Interpretation of the Wave Equation for Two Electrons.

INSTITUTE OF PATHOLOGY AND RESEARCH (St. Mary's Hospital, W 2), at 5 — Dr E D Adrian The Nervous Mechanism of Sensation and Movement.

INSTITUTION OF ELECTRICAL ENGINEERS at 6 — Annual General Meeting

IRON AND STEEL INSTITUTE (at Royal Technical College Glasgow), at 7 — Discussion on A New Method for the Production of Sound Steel by the Hon Sir Charles Parsons and H M Duncan — Third Report on Heterogeneity of Steel Ingots by a Committee of the Institute — First Report on Blast Furnace Plant and Practice, by a Committee of the Institute — Twenty Months Results of Dry Blast Operation, by E H Lewis. — The A I B Sinter Plant at Messrs Guest, Keen and Nettlefolds, Ltd, Cardiff Works by W E Simons

OIL AND COLOUR CHEMISTS ASSOCIATION (at 30 Russell Square), at 7 — F Fancutt Painting as it Affects the Railways

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Colour Group), at 7

OPTICAL SOCIETY (at Imperial College of Science and Technology), at 7 30 — T H Court and Dr M von Rohr Contributions to the History of the Spectacle Makers Company (Second Paper on the Court Collection).

ROYAL SOCIETY OF MEDICINE (Neurology Section) at 8 30. — Annual General Meeting

FRIDAY MAY 10

ROYAL ASTRONOMICAL SOCIETY at 5 — Prof E Hertzsprung The Pleiades (George Darwin Lecture). — E A Kreiken On the Dwarf Nature of Double Stars

PHYSICAL SOCIETY (at Imperial College of Science), at 5 — Dr W E Sumpner Heaviside's Fractional Differentiator — J H Awbery A Simple Method of Fitting a Straight Line to a Series of Observations. — E W H Selwyn Arc Spectra in the Region λ1600 λ2100 — Dr K R Rao The Spectrum of Trebly ionised Thallium — G A Wedgwood The Elastic Properties of Thick Cylindrical Shells under Internal Pressure — A Demonstration relating to Standards of Length and Mass by J E Sears

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (at Abbey Hotel, Kenilworth) at 5 30 — Discussion on Stare Bridge D H Brown Kenilworth Castle and Town S Douglas

ROYAL SOCIETY OF MEDICINE (Clinical Section), at 5 30 — Annual General Meeting

MALACOLOGICAL SOCIETY OF LONDON (in Zoological Department, University College) at 6

ROYAL SOCIETY OF ARTS (Indian Meeting) at 8 — Captain P Johnston Saint An Outline of the History of Medicine in India (Sir George Birdwood Memorial Lecture)

ROYAL INSTITUTION OF GREAT BRITAIN at 9 Prof A E Boycott The Twist of Snail Shells

SATURDAY MAY 11

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (South Wales District) (at Council Chamber Swansea) at 3 15 — Discussion on Some Road and Other Schemes at Swansea, R Hodson Swansea Main Drainage Scheme and Flood Relief Schemes J Hassall Llansamlet Sewage Pumping Scheme Swansea, M E Habershon

ROYAL SOCIETY OF MEDICINE (Balneology and Climatology Sections) (at Harrogate).

PUBLIC LECTURES

FRIDAY MAY 3

UNIVERSITY COLLEGE at 4 — Prof A J Hall Some of the Sequels of Epidemic Encephalitis (Lethargica) — At 5 30 (Succeeding Lecture on May 10) — Prof R Robinson Public Inaugural Lecture

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY at 5 30 — Prof F O Bower The Origin of a Land Flora reviewed 21 Years after Publication (Huxley Memorial Lecture)

TUESDAY MAY 7

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY — ROYAL SCHOOL OF MINES at 5 30 — Prof E de Margerie Some Aspects of French Tectonics (Succeeding Lectures on May 10 and 13)

INSTITUTE OF METALS (at Institution of Mechanical Engineers), at 8 — Sir Oliver Lodge Some Ideas about Metals (Annual May Lecture)

WEDNESDAY, MAY 8

UNIVERSITY OF BIRMINGHAM, at 4 30 — Dr C Singer Medicine and the Revival of Learning

CONGRESSES

MAY 6 TO 11

INTERNATIONAL CONGRESS OF MILITARY MEDICINE AND PHARMACY (in London) — Subjects to be discussed — The Evacuation of Sick and Wounded by Air and Water, Tropical Fevers of Short Duration, Injuries to Blood vessels and their Sequelæ Physical and Chemical Analysis of the Glass and Rubber Articles Employed by the Medical Services The Standard of Dental and Physical Fitness in the Various Military Services

MAY 15 TO MAY 20

ROYAL INSTITUTE OF PUBLIC HEALTH CONGRESS (at Zurich).

Section I — State Medicine and Municipal Social Hygiene
Section II — Industrial Hygiene and Industrial Diseases
Section III — Child Welfare, School Hygiene and Women and Public Health
Section IV — Pathology, Bacteriology, and Biochemistry
Section V — Tuberculosis
Section VI — Climatology and Sports Hygiene
Section VII — Veterinary Medicine and Meat Hygiene

MAY 15 TO MAY 28

WORLD POWER CONFERENCE ON COMPLETE UTILISATION OF WATER POWER RESOURCES (at Barcelona) — Subjects to be dealt with — General Hydrological Problems Technical Problems of Water Power Utilisation Economic and Financial Problems Legal Problems, Protective Measures and Defence Works of Undertakings

SATURDAY, MAY 11, 1929.

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No 3106, Vol 123]

A Royal Commission on the Civil Service

AT the last meeting of the National Whitley Council for the Civil Service, the staff side, at the instance of the Institution of Professional Civil Servants, moved for the appointment of a joint committee of the Council in the following terms

That a joint committee be appointed to inquire into the recruitment, organisation, duties, and pay of the professional, scientific, and technical Civil Servants employed in the scientific, research, and experimental branches of the Public Service, and to make recommendations

In reply, the official side of the Council, speaking on behalf of the Government, stated that while the motion for such a committee could not be accepted, the Government had decided to set up an inquiry into the organisation and lay out of the research departments, upon which persons outside the Civil Service familiar with the problems involved would be invited to serve The Institution, while not satisfied that the views of the staffs it represented would be adequately considered by such an inquiry, decided to await further information before settling the policy it should adopt, and to call an early meeting of the standing joint committee of the Institution and the Association of Scientific Workers

Two days after the meeting of the National Whitley Council, the Prime Minister unexpectedly announced to a women's deputation, not primarily concerned with Civil Service questions, that if returned to power the Government had decided to set up a Royal Commission on the Civil Service, with, it appears, wide terms of reference which would permit of a radical re examination of the structure and organisation of the Service This announcement was received with surprise in official circles, and it was thought in some quarters that the Royal Commission would, in view of the character of its proposed reference, take within its scope the inquiry concerning the research departments The Institution has made inquiries through the staff side of the National Whitley Council, and learns that two separate inquiries are in fact intended

It is all to the good that the special problem of the organisation of research under the auspices of the State should receive expert and impartial consideration The recent Report of the Research Co ordination Sub-Committee of the Committee of Civil Research indicated that there was scope for closer co ordination in certain directions, and better organisation and concentration of control

should lead to a higher status for the research departments, and so to better conditions for the scientific staffs, which lag far behind those of non-scientific civil servants But it is to be hoped that the Royal Commission will be so constituted as to ensure that, in the consideration of the structure of the Civil Service, due regard will be paid to the views of those who hold that science is an integral part of the life of civilised communities, and that economical administration requires a full recognition of the contribution that the technical expert in the wide sense can make towards the promotion of social welfare In the Civil Service the technical expert has little or no authority and is normally regarded as a mere consultant, with the result that his career and status are adjusted accordingly The control of the Service by a close caste of administrators, few of whom have received an advanced scientific training, has inevitable reactions on the part that the man of science, whether pure or applied, is permitted to play in administration Status in the Civil Service, as elsewhere, is reflected in remuneration, and Sir Richard Redmayne has recently pointed out in his presidential address to the Institution of Professional Civil Servants that the highest scientific posts in the Service carry half the salary of the highest administrative posts

The modern State cannot afford to treat in this fashion those upon whom material progress depends Efficiency of the administrative machine must depend upon a ready acceptance of the results of research and appreciation of the need for the scientific approach in the solution of administrative problems A Royal Commission which does not include a number of scientific and professional men of acknowledged authority and experienced in the application of scientific method and discovery to administrative necessities will inevitably produce a report highly coloured by traditional 'establishment' notions in the Civil Service, which will rivet upon the Service for yet another generation a system of control now some two generations old and completely out of touch with modern necessities Mr Churchill, in reply to a parliamentary question, has stated that the object of the Royal Commission is to undertake "a dispassionate and informed examination of the Civil Service from the point of view of its efficiency as a national instrument and of its own well-being" These words are admirable, but we shall await with interest the actual terms of reference, and above all the actual personnel of the Commission

Rays and Waves

(1) *Handbuch der Experimentalphysik* Herausgegeben von W Wien und F Harms Unter Mitarbeit von H Lenz Band 15 *Radioaktivität* Von Prof K W F Kohlrausch Pp xii + 985 81 gold marks (2) Band 18 *Wellenoptik und Polarisation* Bearbeitet von K F Bottlinger, R Ladenburg, M v Laue, Hans Schulz *Photochemie*, von E Warburg Pp xiv + 674 63 50 gold marks (3) Band 19 *Dispersion und Absorption* Von Prof George Jaffé *Medien mit veränderlichem Brechungsindex und Lichtzerstreuung* Von Prof Richard Gans Pp viii + 430 41 gold marks (4) Band 23 *Phosphoreszenz und Fluoreszenz* Teil 1 Von P Lenard, Ferd Schmidt und R Tomaschek Pp xxiii + 741 71 gold marks (5) Band 23 *Phosphoreszenz und Fluoreszenz* Teil 2 Von P Lenard, Ferd Schmidt und R Tomaschek *Lichtelektrische Wirkung* Von P Lenard und A Becker Pp xi + 745 1544 72 gold marks (Leipzig Akademische Verlagsgesellschaft m b H , 1928)

TO the third book of Newton's "Opticks" are appended certain famous Queries, some of which are as applicable to day as when they were first written In Query 17 he asks "When a ray of light falls upon the surface of any pellucid body, and is there refracted or reflected, may not waves of vibrations, or tremors, be thereby excited in the refracting or reflecting medium at the point of incidence, and continue to arise there, and to be propagated from thence as long as they continue to arise and be propagated ? and are not these vibrations propagated from the point of incidence to great distances ? and do they not overtake the rays of light, and by overtaking them successively, do they not put them into the fits of easy reflexion and easy transmission described above ? "

In these days when waves of light pose as corpuscles or quanta, and material particles assume the characteristics of waves (albeit waves in space of many dimensions), the whole of modern physics might be included in the two terms 'rays' and 'waves' But these volumes of the monumental "Handbuch der Experimentalphysik" are more particularly concerned with light waves and the rays from radioactive substances, and there is no danger of misunderstanding when they are summarised under these two headings At the same time, the dilemma which confronts the physicist is reflected in the treatment meted out to the quantum theory by the different authors to whom

the work has been assigned Some accept the theory whole-heartedly, others with evident hesitation

(1) Prof Kohlrausch of Graz has written a complete and impartial account of the science of radioactivity, and we have nothing but praise to give to this admirable volume In some Continental textbooks we have noticed a tendency to belittle or to ignore the work of the Cavendish Laboratory and the Cambridge physicists No such tendency is to be found in this volume, where we meet repeatedly the names of J J Thomson, C T R Wilson, E Rutherford, and their numerous fellow workers The longest chapters in the book are devoted to gamma rays—a subject to which Prof Kohlrausch has made important contributions—beta rays, and alpha rays Very remarkable are the results obtained by the use of Wilson's cloud chamber, by means of which the tracks of such rays are made visible In particular, mention may be made of the stereoscopic pictures by Meitner and Freitag (Figs 169 and 170), in which the path of a hydrogen particle set in motion by the impact of an alpha ray is clearly marked Some of Blackett's photographs are also well reproduced We have taken special interest in the account of the H rays, including the description of Stetter's experiment, using Aston's mass spectroscope to show that the mass of such a particle is identical with the mass of the hydrogen atom

(2) The greater part of vol 18 is devoted to physical optics Rudolf Ladenburg gives an interesting critical account of the measurements of the velocity of light, taking Michelson's latest value, $c = 299{,}796$ km /sec , as a standard In an added note it is pointed out that this is in close agreement with the value deduced by the astronomical method (H Spencer Jones) [1]

M v Laue is responsible for valuable articles on the optics of moving bodies, the reflection and refraction of light at the interface between isotropic bodies, and the interference and diffraction of electromagnetic waves (with the exception of X rays) The first of these contains information as to recent researches not easily available to the student The same remark applies to Bottlinger's short article on the relativistic displacement of spectral lines towards the red and the bending of light in the gravitational field of a star The polarisation of light is well treated by Hans Schulz, who gives a careful account of historical and modern experiments and apparatus—we notice references are made to instruments by Hilger and by Bellingham and Stanley Reproductions are given of the striking interference patterns of crystals due to H Hauswald

A short article of 40 pages by E Warburg on photochemistry is included in this volume The author seems to have imposed severe restrictions on himself in his treatment of this subject, and the result is somewhat disappointing This arises in part from the complexity of the material, for although the quantum theory affords some explanation of the simpler photochemical processes, the reactions are in general complicated by secondary changes which cannot at present be traced in detail or subjected to critical analysis When absorption of incident radiation takes place, an electron is raised to a higher quantum level, or in other words, energy of radiation is transformed into quantum energy It is now assumed that, by interaction with another molecule, this quantum energy can be changed into another form of energy, in this case, chemical energy

To set up and preserve the laws of statistical equilibrium a particular process can in general never be supposed to act alone, unaccompanied by a corresponding reverse process , only the two together form a possible single mechanism of interaction Collisions between electrons and atomic systems may be divided into two types, those in which kinetic energy of electrons is changed into quantum energy of atomic systems, and those in which the inverse change of quantum energy into kinetic energy of electrons occurs In thermodynamic equilibrium there must be just as many collisions of one type as of the other According to Franck, this conclusion must also be drawn with regard to the collisions between excited and unexcited atomic systems

(3) Vol 19 of the 'Handbuch', though less bulky than some of its companions, deserves special attention, as it has to do with subjects of great theoretical importance Prof Jaffé, of Giessen, writes on the related topics of the dispersion and absorption of light After a short historical introduction the classical theories are discussed briefly but adequately The theory of dispersion was first suggested by Maxwell in a question in the Cambridge Mathematical Tripos of 1869, but important work was done by Sellmeier (1871), who independently advanced the view that the differences in the velocity of light in different materials must be attributed to the direct action of the vibrating particles of the medium set in oscillation by the ether vibrations The electromagnetic theory of dispersion is then described, and the

[1] See NATURE, vol. 120, p 602, 1927

later developments consequent upon the adoption of the electron theory discussed Next we have an account of the application of the quantum theory to the problem, leading up to the dispersion formula of Kramers, and finally to the new quantum mechanics—a truly notable record of scientific progress The experimental aspects of the sub ject are next taken up, gases, liquids, and solids being considered in turn, and comparison between theory and experiment being kept in view through out Chapter vi deals with several related questions of great interest, such as the number of dispersion electrons, and the probability of quantum transitions

Part II consists of three chapters dealing with absorption, commencing with an account of the theories, including the collision theory of Lorentz and also the theory of Planck, in which the damping is referred solely to radiation Then follow descriptions of experimental methods and of the results obtained for gases and vapours, liquids and solids The whole work is well done and deserves high praise

Prof Gans of Königsberg contributes a short chapter on media with variable refractive indices, and a further three chapters, which, in view of the growing importance of their subject, might well have been longer, on the molecular scattering of light

(4) The difficulty of dealing with the vast amount of material accumulating as the result of modern scientific research is illustrated by the volumes on phosphorescence and fluorescence The method, which consists in abstracting or reproducing in considerable detail a large number of original papers, is far from attractive In the opinion of the reviewer, who sympathises with the authors in their task, more severe pruning and more critical selection would have increased greatly the value of the resulting work We hold that the author of such a volume need not attempt to provide an exhaustive account of all available data, even were that humanly possible, but rather to supply a judicious and stimulating survey of the main facts and theories In the subject of luminescence the difficulty is acute, arising in part from the fact that the development of the theory has not kept pace with the increase in the number of facts of observation and experiment

The historical method is followed in the earlier part of the volume, which begins with an account of the observations of Canton, Stokes, and Becquerel, followed by a description of the work of Klatt (to whom the book is dedicated), of Lenard and his fellow workers, notably Hausser and Saeland We can do no more than mention the investigations of Gudden and Pohl on the electrical conductivity of phosphorescent materials when illuminated, and the work of the same investigators and of Schmidt on the dielectric constant of the material

(5) The second part of Vol 23 contains five chapters which conclude the discussion of phosphorescence and fluorescence, and five more covering some 500 pages which are concerned with photoelectric activity In the chapter on fluorescence, it is pointed out that the time during which the emission continues after the cessation of the stimulus does not afford a sharp criterion to enable us to distinguish between fluorescence and phosphorescence It is suggested that a better criterion may perhaps be found in the photoelectric effect, which postulates the complete separation of electrons from the active centres of the phosphore in all cases of phosphorescence of long duration

Of outstanding interest are the researches of R W Wood and others on the fluorescence of gases and vapours When sodium vapour is illuminated by sodium light, some of this light is re emitted without change of wave length as *resonance radiation* But, in addition, other monochromatic radiations, forming *resonance spectra*, are given out when the vapour is illuminated by the light of metallic arcs Recent investigations have done much to unravel the complicated line spectrum obtained in this way

The section on photoelectricity is mainly due to A Becker, and even if emphasis is laid on the work carried out by German investigators, it is useful to have the results summarised by one who has himself made important contributions to the subject We may mention in particular his work on the relation between photoelectric and thermionic emission The reviewer turned at once to the chapter on photoelectric fatigue, and was interested to find that this perplexing phenomenon is attributed by the author mainly to the influence of gas (ozone) or vapour (water vapour) on the emission of electrons The final chapter is on the practical applications of photoelectricity, and refers to the increasing importance of photoelectric cells in photometry

It was by studying the energy of photoelectric emission that Einstein in 1905 was led to the theory of light quanta, which seemed in direct antagonism to the wave theory of light The energy of the light quantum of frequency ν was assumed to be $h\nu$ where h is Planck's constant

We may conclude with a question put by Schrödinger at the end of his lectures on wave mechanics Is it quite certain that the conception of energy, indispensable as it is in macroscopic phenomena, has *any* other meaning in micro-mechanical phenomena than the number of vibrations in h seconds? H S ALLEN

The Evolution of Human Races

L'Ologenèse humaine (Ologénisme) Par Dr George Montandon Pp xi + 477 + 14 planches (Paris Félix Alcan, 1928) 200 francs

DR GEORGE MONTANDON is known to anthropologists because of the contributions he has made to our knowledge of the Mongoloid peoples of Asia, of the inhabitants of Abyssinia, and of the primitive cultures of Africa In the present imposing book he appears as the author of a work on systematic anthropology He has here attempted to do two quite separate things to give a systematic account of the living races of mankind—of which he distinguishes twenty—and at the same time to apply a new theory to explain the origin of human races The theory of evolution which he applies is that formulated by Prof Rosa of Modêna in 1918 and named by its originator 'ologenesi' (holos, entire) We think the author would have done much better to have written two books—one for the exposition of the theory he has adopted, and utilised the other for his valuable data and charts relating to the descriptive ethnology of mankind In brief, the theory is the weakest part of Dr Montandon's book, and many anthropologists may turn away before they reach the really valuable chapters We also think that the earlier chapters, which attempt to trace the origin of the earth and of life, might well have been omitted

After citing the various theories which have been formulated to explain the origin of new species—Lamarckism, Darwinism, neo Lamarckism, neo Darwinism, mutationism, etc —the author rejects them all in favour of Rosa's 'ologénisme', and proceeds to apply this theory to explain the facts of human evolution It is not necessary to enumerate all the postulates of his theory, they are numerous and arbitrary We need only mention two or three which are essential to understand its application to a race of human beings The theory presumes that every man, woman, and child of a race is 'wound-up', so that all, after passing through a certain number of generations, will arrive at a critical or maturation stage On this stage being reached the whole species divides, half of the individuals being changed into one kind of race, the other moiety into another Races 'unwind' and reach critical stages at different rates—some rapidly, others slowly—so that a backward race may be a true cousin of another which is highly advanced The theory is determinist in nature, but environment, habit, and competition are operative and modify the result Races have also arisen by hybridisation Further, as mankind is and has been distributed over wide areas of the world for long geological epochs, each area being the scene of independent advance, it is foolish to speak of, or search for, a limited area of origin or cradle for mankind Under this theory a new race appears at the same time over a wide area

In a brief notice such as this, it is impossible to give a full exposition of Dr Montandon's ideas, but enough has been stated to place the reader in possession of their trend Their practical application, even in Dr Montandon's hands, requires a considerable degree of constraint to make facts fit with expectation On the other hand, the author never shirks facts, he has searched all the latest literature dealing with blood reactions, immunity, etc, and sought to fit them into his scheme Indeed, the book is a valuable repository of fact, even if the theory of 'ologénisme' proves to have little or no permanent value

Chemistry and Physics of Sea Water

Biological Chemistry and Physics of Sea Water By H W Harvey (Cambridge Comparative Physiology Series) Pp x + 194 (Cambridge At the University Press, 1928) 10*s* 6*d* net

THIS book deals with the particular chemical and physical conditions in the sea which appear to be most important in affecting the growth of plants and animals The author reviews the results of researches subsequent to the publication of Krümmel's "Handbuch der Oceanographie" in 1911 Since H M S *Challenger* led the way in 1872, there has been a steady increase in the number of vessels investigating the high seas, while at the same time marine biological stations established in increasing numbers in different countries have investigated the conditions in coastal waters The combination of a laboratory on shore with a small sea going vessel has proved particularly fruitful, and provides the author with much of the material for this book

Chapter i gives a brief summary of the general physiology of marine organisms, the factors controlling photosynthesis, and the relation of the

animals to changes in oxygen tension, temperature, and light The part played by the so called dissolved organic matter is still obscure, but it is probably important Chapter ii deals with the chemical composition of the water, the dissolved salts and gases, and the hydrogen ion concentration Practical details for the estimation of the more important substances are given There is an interesting table of the elements occurring only in minute traces in the sea, of which there is a large number Many of these rare substances are extracted from the water by the organisms, and they may assist or even replace related substances in metabolic processes, as copper replaces iron in the respiratory pigments of the Crustacea

Recent work on the supply of food materials for the phytoplankton has shown that the nitrates and phosphates are formed in the deeper layers and are brought to the surface by currents This dependence of the phytoplankton (and of course ultimately all the plankton, great and small) on currents leads to considerable space being devoted to water movements The understanding of these movements is facilitated by a number of clear diagrams A short account is given of the recent work of Bjerknes and Sandström on the mathematical treatment of currents Chapter iv deals with the gain and loss of heat by the water and with the currents, which are largely responsible for the vagaries of temperature that are found in many places The study of the distribution of temperature with depth shows that in summer a layer of warmer water from 10 to 50 metres in depth overlies a layer of colder water, there being a difference of temperature of several degrees between the two This condition, which occurs regularly in the summer in lakes in temperate regions, has only recently been noticed in the sea, although many of the old temperature records show it quite clearly The difference in density between the two layers prevents them mixing freely, and so prevents the phosphates and nitrates formed in the deeper water from reaching the surface where they can be utilised by the plants A prolonged period of fine weather in summer may therefore cut off the food supply of the phytoplankton

Chapter v deals with the colour and the penetration of light into sea water There is here a considerable field for experimental work, apart from that on photosynthesis, on the effects on marine organisms of light of different wave lengths Chapter vi concludes with a brief review of factors influencing the fertility of the sea and its fluctuations Here we are no nearer the solution than we are to solving the problem of the fertility of the soil, and one of the greatest difficulties in the way is that we know so little of bacterial activity

The author has succeeded in presenting the reader with a clear review of the present position of the study of the physical environment in which marine organisms live There is a list of references to recent literature at the end of each chapter, which adds to the value of the book It can be recommended to all who are interested in the sea, and particularly to those who are studying the physiology of its inhabitants

Our Bookshelf

Lehrbuch der Experimentalzoologie Experimentelle Entwicklungslehre der Tiere Von Prof Dr Bernhard Dürken Zweite Auflage Teil 1 Pp 320 Teil 2 (Schluss) Pp xii + 321 782 (Berlin Gebrüder Borntraeger, 1928) 51 gold marks

IN his first few pages the author of this book defines very accurately the scope of the subject with which he deals It is to include all branches of the analytical study of development in the animal organism considered as a whole, but not that of its parts considered separately In the book he therefore discusses heredity, fertilisation, and the differentiation of specific form He does not deal with the growth of the body in size Having so defined his subject, he proceeds to name it " Experimental Zoology " The use of this title is open to objection from many points of view In the first place, it is not descriptive The experimental method is now used, or is coming to be used, in all branches of the science, wherever its use is effective Its use is certainly as characteristic of many other branches as it is of the subject of this book But a more important objection is that a classification of a science by the methods used in its various branches must always be unsound In zoology this type of classification has been widely used and owes its origin to the history of the science To speak of experimental zoology to day in the sense of the author of this book, or in any similar sense, is an anachronism It would surely be better to allow the term to fall into disuse and to name all the sub divisions of the science according to the subject matter of each It would not be difficult to choose such a title for the subject of this book

Probably the chapters which deal with the experimental study of differentiation will be of most use to biologists outside Germany This is a subject which German biologists have made particularly their own, and a good summary of their recent work upon it was needed This need the book seems to supply The other parts of the subject have been more frequently summarised, and the account given here is often short and sometimes incomplete In particular, only some of the aspects of fertilisation are discussed, and a theory is put forward in regard to it with which by no means all workers upon the subject will agree

It is perhaps not surprising that the examples

quoted are largely results obtained by German workers Numerous examples could be given in which work of apparently equal or greater importance by other biologists is not discussed In other respects the second edition of the book appears to have been brought up to date It should be useful to biologists in Great Britain

A Laboratory Manual of Elementary Physical Chemistry By Prof Edward Mack, Jr, and Prof Wesley G France Pp xi+195 (New York D Van Nostrand Co, London Macmillan and Co, Ltd, 1928) 8s 6d net

THE laboratory manual of Profs Mack and France begins with three theoretical "Exercises", dealing with units and dimensions, significant figures, and errors of experiment, respectively These are followed by a series of thirty five experiments, of which two are concerned with determinations of molecular weights in solution, two more with conductivities and transport numbers, two with the preparation of a standard cell and the study of a concentration cell, whilst the hydrogen electrode and indicators form the subject of two more experiments in the electrical section of the book These experiments provide adequate samples of measurements of those properties of dilute solutions of electrolytes which have occupied such a prominent position in physico chemical literature during the past forty years, but they leave room for an exceptionally large proportion of experiments with gases and liquids other than dilute solutions

The course is therefore exceptionally well balanced, and can be recommended on account of its progressive outlook The text dealing with the individual experiments is well written, and is presented in an attractive form The manual is a competent and trustworthy guide for a laboratory course of thirty six periods, and would serve as a good preparation for more advanced work in physical chemistry

The Year Book of the Scientific and Learned Societies of Great Britain and Ireland a Record of Work done in Science, Literature, and Art during the Session 1927–1928 by numerous Societies and Government Institutions Compiled from Official Sources Forty-fifth Annual Issue Pp vii+420 (London Charles Griffin and Co, Ltd, 1929) 18s net

A NOTE of warning is sounded in the preface to the new issue of this valuable annual The publishers state that for some years past "the heavy cost of production has been altogether out of proportion to the sales", and that although they are anxious to continue their part, they cannot do so without more support

As usual, the societies included are grouped in fourteen sections according to the subject of their activities Societies with London headquarters come first, followed by provincial, Scottish, and Irish societies In each case the address, officers, and particulars of meetings, membership, and publications are given, followed by a list of papers read during the session 1927–28 Incidentally, it is remarked that in future, only papers which are published are to be included, so that the Year Book will be an index of published work, and as such alone the volume must be of considerable service Government departments such as the National Physical Laboratory are included in their appropriate sections

The thanks of scientific workers generally are due to the officials of the societies who have co operated with the publishers in making the Year-Book not only available but also authoritative We hope with the publishers that sufficient sales will be forthcoming to make possible the continuance of this useful reference book

Preparation of Scientific and Technical Papers By Prof Sam F Trelease and Emma Sarepta Yule Pp 117 (London Baillière, Tindall and Cox, 1927) 7s net

IF every beginner, and some experienced transgressors, were to digest the contents of this little book before again attempting to place on printed record the method and results of a scientific investigation, critics of the quality of such contributions to literature would in large measure be deprived of illustrative material, of which there is at present no lack Indeed, had the advice which the authors offer been less well founded, and their specific directions less generally acceptable than is in fact the case, they would still have rendered notable service in emphasising the importance in such matters of clear and logical presentation, of attention to detail, and of a reasonable measure of uniformity Thus, whilst there may be two opinions concerning some of the individual instructions, there can be one only concerning the value of the book as a whole The subject matter deals concisely with the arrangement of a paper and its preparation for the press, and the attention which is afterwards required of the author, it includes a description of methods of citation, abbreviation, tabulation, and illustration Editors and readers of scientific literature will agree that there was room—on many a shelf—for such a book A A E

A Classbook of Practical Chemistry First Year By J Morris Pp viii+103 (London Methuen and Co, Ltd, 1928) 2s

THIS book is intended for pupils commencing the study of chemistry A new feature is that the directions for carrying out experiments are given on the left hand pages, while the results are described on the right hand pages, and the author suggests that "by the adoption of some simple method of covering, the right hand page is completely hidden during practical work" The success of such a scheme must depend largely upon the teacher and upon the age of the pupils The instructions for carrying out experiments are simple and clear, but the scope of the book might with advantage have been slightly extended to include such experiments as the preparation of hydrogen and nitrous oxide The melting and boiling points of sulphur are given as 115° C and 448° C instead of 112 8° C and 444° C respectively The equation for the reaction of magnesium with carbon dioxide (p 39) is incorrect

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications]*

Ozone Absorption during Long Arctic Night

IN NATURE of April 27, p 644, Prof R W Wood again raises the hopes of astronomers that it may be possible to obtain an extension of the ultra violet spectra of the sun or stars by going to a station near the pole at the end of the winter He assumes—as most people have done—that the ozone in the atmosphere is formed by ultra violet radiation from the sun, and since it is the absorption by ozone which causes the abrupt extinction of stellar spectra at about 3000 A , he naturally concludes that this absorption would be least where the upper atmosphere has had least sunlight

I fear that it is necessary to dash any such hopes of astronomers, and possibly this note may save someone from the discomforts involved in a fruitless expedition to high latitudes in the winter We have now, by the kindness of a number of helpers, a series of observations extending over many months at twelve stations, ranging in latitude from 70° N to 45° S These observations are quite regular and consistent, and show that the lowest ozone values are found in tropical regions at any time of the year, while the highest ozone values are found in high latitudes in spring In the tropics there is practically no annual variation, but in high latitudes the annual variation is very large (the maximum amount of ozone is about twice the minimum amount), the maximum being in spring and the minimum being in autumn The autumn values in high latitudes are nearly as low as those in the tropics, so that while in the spring hemisphere the amount of ozone increases rapidly from the tropics to the pole, in the autumn hemisphere the amount of ozone is nearly constant at all latitudes

These results are, of course quite inconsistent with the suggestion that the ozone is formed by ultra violet radiation from the sun The shortest wave lengths from the sun will undoubtedly form ozone, but the longer waves which are strongly absorbed by ozone will decompose it As there is so much more energy in the band of longer wave length, it is not surprising that the equilibrium amount of ozone, when the atmosphere is subjected to both wave lengths, should be very small What forms the ozone is not, at present, certain, but the connexion found between the amount of ozone and magnetic disturbance might suggest some action associated with the aurora, though occurring lower down (the ozone appears to be at a height of about 40 to 50 km , while the minimum height of the visible aurora is about 90 km) Whatever the action forming ozone, it is clear that the equilibrium amount due to sunlight is always smaller than the amount actually present, so that the sunlight *tends to reduce* this amount

If astronomers wish to get spectra extending as far as possible into the ultra violet, they should go to the tropics, or should choose days in temperate regions during the autumn with anticyclonic conditions and a tropical air current above, as under these conditions the amount of ozone is as low in temperate regions as in the tropics

G M B DOBSON

Boars' Hill, Oxford, April 27

Thyroid and Temperature in Cold-blooded Vertebrates

THE thyroid is well known to be concerned with temperature regulation in homothermic animals It seems, however, also to have a somewhat analogous function in cold blooded forms In an experiment undertaken to investigate the temperature coefficient of metamorphosis, a number of sets of half grown *Rana temporaria* tadpoles, after all being exposed to the same concentration of filtered thyroid suspension in water for the same length of time, were placed at various temperatures from 3° to 30° C The thyroid dosage was moderate, sufficient to produce metamorphosis in about a week at room temperature

As expected, temperature exerted a marked effect on metamorphic rate Those exposed to temperatures below 5° C , however, provided a surprise After showing a certain degree of change, they proceeded no further in metamorphosis Even when removed to room temperature, they continued indefinitely in this half and half condition, as shown in the photograph (Fig 1), taken several weeks after removal

That permanent intermediate conditions between larva and adult could be obtained in urodeles was already known from the work of Jensen and others on axolotls This is, I believe, the first case in Anura It confirms the view that metamorphosis is not an all or nothing reaction The relation to temperature, however, is what especially concerns us here The half and half state can only be interpreted as follows (1) the treatment with thyroid *ab extra* causes a marked compensatory reduction in the animal's own thyroid (a fact well known in amphibian experiments), (2) some of the effect of the thyroid dose, which causes rapid metamorphosis at higher temperatures, is here used up in counteracting the effect of low temperature instead of in producing metamorphosis

FIG 1

Something of the same sort can be deduced from other work, such as that of Adler, who found that in untreated tadpoles high temperature caused regression of the thyroid, low temperature hypertrophy, both in growth and functional activity

The conclusion appears to be justified that in tadpoles the thyroid is acting as a primitive temperature regulator, or rather as a *temperature buffer* The metabolism of tadpoles is lower in the cold than in the hot , but thanks to the thyroid's hypertrophy in the cold and regression in the hot, and to the fact that thyroid secretion increases metabolism, the difference is not so great as it would be without a thyroid On this view, the temperature coefficient of oxygen consumption and other metabolic activities should be greater in thyroidless than in normal tadpoles It would be of great interest for anyone who has command of the technique of thyroidectomy in frog embryos to put this deduction to the test

JULIAN S HUXLEY

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Mimicry

IN NATURE of April 27 there appears an article on mimicry by Dr Hale Carpenter, of Uganda, in which he pays me the compliment of quoting extensively from an essay of mine on evolution which appeared in the volume "Evolution in the Light of Modern Knowledge" In Dr Carpenter's article he asserts

that 'natural selection' affords the only satisfactory explanation of mimicry, and he criticises the tentative explanation which I put forward

I quite freely admit that I am unable to give an explanation of the numerous facts adduced by Dr Carpenter To do so would require years of original work in each locality, the environment, both physical and biological, would have to be thoroughly analysed in each case, which notoriously has not been done We should have to account for the fact that in some cases the supposed model is rare and the mimic far more numerous, and we should have to deal with the distressing circumstance that evidence for serious attack by birds on butterflies in the adult condition is sadly lacking Bergh in his "Nomogenesis' states that only one example of this was known to him, and that was in Ceylon, where the bee eaters (Meropidæ) devour large numbers of the supposedly distasteful Danaidæ '

Of one thing, however, I am certain, and that is that natural selection' affords no explanation of mimicry or of any other form of evolution It means nothing more than 'the survivors survive' Why do certain individuals survive? Because they are the fittest How do we know that they are the fittest? Because they survive Is not this a mere form of words, just as deserving of condemnation as the phrase 'the Will of God' used by Darwin s theological opponents?

That more young are born than can survive was known to Lamarck, and is explicitly set forth in his 'Zoological Philosophy, but he did not make the mistake of supposing that the killing of James can affect the qualities of Tom Put in other words, natural selection can only 'select' what is already there, and the real problem for science is how what is there came into existence Towards the solution of this problem, so far as it affects the wing colours of butterflies, very little has as yet been done, nevertheless, a beginning has been made Sir Frederick Gowland Hopkins has shown that uric acid forms the white background in the wings of Pieridæ, and my friend, Dr D L Thomson, now lecturer on bio chemistry in McGill University, Montreal, has shown that in another family the colour of the background is due to a substance in the plant on which the larva feeds Only along such lines as these will the problem of animal coloration be solved

When the school to which Dr Carpenter apparently belongs are asked how the variations which are 'selected' originate, their only answer is chance, and 'chance' as an explanation of a regularly recurring biological phenomenon does not commend itself to me E W MACBRIDE

Imperial College of Science,
South Kensington, S W 7

DR HALE CARPENTER in his article on mimicry (NATURE, April 27) mentions that it is held by many as an objection to the theory of the evolution of mimetic forms by natural selection that the mimic must be mistaken by the predatory animal for its model, if the resemblance is to be of any use to it, and that therefore slight resemblances will be useless, and the evolution of the perfected resemblance unintelligible This difficulty, he suggests, may be removed by the consideration that the mimic need only *remind* the enemy of its model to set up a repulsion in its mind and so escape He instances our repulsion to a worm, which he attributes to its resemblance in form to a snake, for which we have an ancestral repulsion

Is this necessary? Does not the objection in any case rest upon far too anthropomorphic a conception of the animal mind? Psychologists tell us that the animal may be regarded for practical purposes as unreasoning in everyday life If this is so, the mental processes of an animal such as a bird in searching for its prey will be very different from ours in looking for an object We, as we examine the bark of a tree for an insect, are continually comparing the form of each piece of bark with that of the insect, and considering whether it is bark or insect The bird will not consider, its glance will pass over the bark, often slowly and with *apparent* care, until some object, by its resemblance to the remembered picture of the insect, starts the feeding reaction There is no conscious comparison, the stimulus is received and the reaction follows instinctively To protect the insect, its resemblance to the bark need only be sufficient to keep the stimulus, when the bird's glance lights upon it, below the threshold value for the reaction

Protective resemblance and mimicry are here entirely parallel The probability of stirring up the feeding reaction will be less the more perfect is the resemblance either to an inedible animal or to an inanimate object, but it seems that a very slight resemblance may often be effective We know how readily we may mistake objects at a first glance, especially when our minds are inactive, for others to which they have only a slight resemblance A man, waking from sleep, may mistake clothes thrown over a chair for a person in his bedroom A second glance, always accompanied by thought and comparison, shows him his mistake, but for the animal there is no such thought and comparison Hudson ('Birds and Man, Dent, 1923, pp 46 8) has an account of an incident in which he was mobbed at dusk by a flock of goldcrests, and later by another of swallows and house martins in full daylight The behaviour of birds was due, as he afterwards showed, to the resemblance of the colour of his cap to that of the fur of a cat The acuteness of the vision of the predatory animal only enters indirectly into the problem The bird's vision may be easily acute enough to distinguish the differences between the mimic and its model, just as the swallows could certainly have appreciated the difference in form between the cap and the cat Yet the differences may be unperceived and the resemblance effective, even when it is slight These considerations seem to remove the difficulty, felt by many, in the evolution of mimicry and protective resemblance from beginnings which must have been very imperfect G S CARTER

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University of Glasgow

Anomalous After-Effect with Quartz

THE true and the apparent resistivities of some dielectrics have been found by S W Richardson (*Proc Roy Soc*, A, **92**, 1916, **107**, 1925), one of the writers (the paper is now in the press at the Tôhoku Imperial University), and others The apparent resistivity of quartz under a certain constant applied potential increases rapidly with time and then gradually tends to a saturation value after about 30 minutes for quartz plate cut perpendicular to its optical axis (The resistivity is measured by conducting charge through dielectrics under various applied potentials, and the time means the duration of the application of a constant potential)

It may be expected from the paper of one of the writers (*Sci Rep Tôhoku Imper Univer*, **10**, 101, 1921) that the apparent resistivity will show some anomaly for applied potential which increases beyond the 'limit potential' Thus, we found an anomalous after

effect on the apparent resistivity of quartz plate cut perpendicular to its optical axis First, we put a known potential on the quartz during a constant time interval (always 10 minutes), in this time interval the quartz is made to conduct the electric charge freely, and it is connected to earth during a known time interval, then putting on a known potential, the accumulated charge due to conduction is measured during a known time interval, in this case the apparent resistivity is much smaller than that of the quartz in neutral state Next, it is earthed until the residual charge and the time effect due to the latter potential have completely disappeared, and then the measurement of the apparent resistivity is made under the same external conditions as the above during a known time interval, and then it is earthed in this case the apparent resistivity is a little larger than that of the first, but yet smaller than that of neutral state

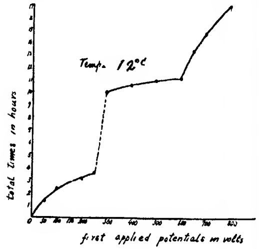

FIG 1

The measurement and earthing as above are repeated until the effect of the first applied potential disappears The variation of this total time interval for the first applied potential which affects the apparent resistivity as an after effect is given in Fig 1 The potential for measuring the apparent resistivity is always 50 volts The temperature of the quartz is always kept at 12° C As shown in Fig 1, the time interval during which the after effect exists increases slightly with the potential and is discontinuously increased at the potential between 300 350 volts per mm thickness (250 300 volts for actual thickness), and again slowly increases, and from about 700 volts per mm thickness (600 volts for actual thickness) it increases rapidly, and it seems that it gradually tends to a saturated state In the paper of one of the writers above referred to, the limit potential is most important for dielectrics, and for quartz is equal to 324 volts per mm thickness as the mean value from the residual charge and time effect Thus it can be concluded that the anomalous after effect appears at the limit potential

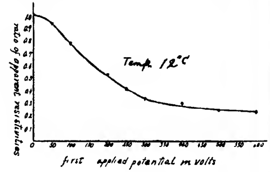

FIG 2

Fig 2 shows the variation of the ratio of the apparent resistivities at 5 minutes after the first earthing and the neutral state, with respect to the first applied potentials, the rate of decrease of the apparent resistivity increases rapidly in the neighbourhood of the limit potential and then gradually tends to a saturation value

The decrease of the apparent resistivity and the appearance of the anomaly are exactly the same in both cases, the first applied potentials are positive and negative, and the after effect depends simply on the absolute value of the first applied potentials Hence it seems to us that this anomalous after effect is probably due to some property of the atomic lattice of quartz

H SAEGUSA
S SHIMIZU

Institute of Physics,
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Mar 2

Plasticity and Water Absorption of Clays

IN spite of the cause of the plasticity of clays having been the subject of much speculation, no generally accepted theory appears to have been developed The following measurements of water absorption and some other properties of clays throw further light on the problem and appear to me to be of general interest in the theory of the properties of colloids

The 'water absorbed' was measured by determining the increase in concentration in chloride ions which occurred when the clay, dried at 100°, was added to a standard solution of the chloride of the base with which the clay was saturated, it having been proved by various workers that clay does not absorb the chlorine ion Five grams of clay were usually added to 10 c c of solution, after centrifuging, the weighed decanted liquid was titrated with silver nitrate solution This method of 'negative absorption' seems to have been strangely neglected in the study of the water affinity of colloids in spite of its use by McBain in the study of soaps, and by Gaunt and Francis for silica, and ferric, and aluminium hydroxide gels (*Trans Faraday Society*, **24**, 32, 1928) The other three properties tabulated were determined on the soil which contained 60 per cent of clay. The relative 'hardness' figures represent the percentage material which failed to be powdered after a standard shaking treatment of dried pellets of each material The Atterberg

TABLE I

CLAY FROM HEAVY COTTON SOIL NO 38724

Base in Clay	Water absorbed from Chloride Solutions per 100 gm of Clay		Plasticity Number	Relative Hardness	Bulk Density
	N	*N*/10			
Li	18 4	46 5	82	92	2 12
Na	12 8	34 4	60	85	2 07
Mg	10 4	17 4	56	82	2 01
Ca	8 3	16 8	42	57	1 80
NH_4	5 2	15 4	22	6	1 70
K	2 7	15 1	22	1	1 45
H		5 3	20	0	1 65

plasticity number represents the range of percentage water content over which the soil remains plastic

This direct demonstration of the lyophilic series correlates nearly perfectly with the other properties tabulated Preliminary counts in an ultra microscope of the number of particles per gram of clay seem to indicate that the ultimate dispersion of these clays will also follow the order of hydration, but it should be emphasised that this is not the same as the order of the flocculating concentrations of the different clays by the chlorides of the respective bases

These figures show clearly how the properties of one clay with different bases follow the water absorption of the clay, Table II shows in a preliminary way how the plasticity of different clays with the same base (sodium) also follows the water absorption The properties of some of these clays have been described by Joseph and Oakley (*Jour Agr Science*, **19**, 121, 1929)

TABLE II

Clay from—	SiO_2/Al_2O_3	Water absorbed from $N/10$ NaCl by 100 gm Clay	Plasticity Number of Soil	Clay (per cent in Soil)
Bentonite	7	41 8	441	91
38724	4 0	31 3	60	62
30100/1	3 7	28 5	56	74
29933/4	2 7	26 6	37	57
13107	2 4	18 5	20	80
Amorphous silica		15 1	about 1	
Kaolin 10096	2 0	3 0	about 1	about 64

Although the clay contents of the soils are not comparable, the influence of the composition and hydration of the clays is still sufficient to determine the plasticity This is particularly striking in the low plasticity of No 13107 This soil contains 80 per cent of a clay which, as shown by the ultra microscope, contains more than twice as many particles as No 38724 It is evident that although the fineness of a clay may be a factor in its plasticity, the water affinity is more important

Finally, the water absorbed by a clay is greatly influenced by the concentration of the reference salt used in the solution This is presumably an osmotic effect Below is shown the effect of different concentrations of sodium chloride on the water absorbed by sodium 'saturated' clay No 38724

Dilution of NaCl (litres)	0 2	1	10	25	50	125
Water absorbed per 100 gm dry clay	6 7	12 8	34 4	49 0	80 0	102

In keeping with this change in absorbed water the plasticity number fell 13 units when normal sodium chloride solution was used instead of pure water Experiments at higher dilutions are rendered difficult by the deflocculation of the clay At present it is impossible to decide whether this phenomenon of water absorption is due to imbibition by hypothetical gels in the clay or to a kind of polar absorption round each clay particle as postulated by Hatschek for other colloids (*Jour Phys Chem*, **31**, 383, 1927) and others (Weisner and Cunningham, *Jour Phys Chem*, **33**, 312, 1929) In view of the increase of dispersion with hydration observed in the ultra microscope and the impossibility of separating a clay into two fractions of markedly different properties, I incline to the latter view

H B OAKLEY

Wellcome Tropical Research Laboratories,
Khartoum, April 7

Co-education

IN NATURE of April 13, I note an article which seems to me to maintain the thesis that co education in the medical schools of London is undesirable because its prevalence would interfere with the efficiency and success of the London School of Medicine for Women I would suggest that your brief against co education is carried considerably farther than the highest authorities at the London School of Medicine for Women really desire, if one may judge from a letter to the *Nation and Athenæum*, written by Sir Francis Acland, the chairman of that School, dated April 9 In that letter Sir Francis expresses a pained surprise at my suggestion that the London School of Medicine for Women objects to co education He declares 'All the evidence given by the School before the Committee" (that is, the recent University Committee) "was in favour of co educational facilities, and we have always welcomed every extension of it" The 'quota' system, which is condemned in NATURE, was first suggested by the Professorial Board of University College in 1915, since which date University College Hospital has taken a quota of twelve female students annually, and the system has worked with complete success

You ask why the recent University Committee, appointed on the motion of Mr Walter Spencer and myself, should have declared that there was a "prepossession in favour of co education in the University" The reason is probably to be found in the report of a previous University committee in 1915, which had investigated this very question of medical co education at the men's schools of London That report was overwhelmingly in favour of co education as a principle It is significant that the large majority of women's societies have taken the view that co-education should be practised in the medical schools of the University of London as it is practised in provincial universities

E GRAHAM LITTLE

House of Commons, S W 1, April 18

DR GRAHAM LITTLE is well known as a champion of medical co education, and we print his letter on the subject with pleasure The article in NATURE was not intended to indicate any general objection to co education, but we suggested that the question of medical co education in London constitutes a special problem since a well organised system of unisexual medical schools is already in existence Conditions in 1915 during the War were quite exceptional, and the view then taken on the question of medical co education cannot be regarded as binding the University We retain our dislike of the 'quota' system, notwithstanding Dr Graham Little's interesting evidence as to its origin and working

THE EDITOR

Active Nitrogen

THE recent analysis of the band spectrum of nitrogen in the Schumann region by Profs R T Birge and J J Hopfield (*Astro Jour*, **68**, p 274, 1928) throws a flood of light on the identity of active nitrogen It has been shown that the bands in the Schumann region have nothing in common with the bands in the visible and the ultra violet The presence of a strong metastable level in the N_2 molecule has thus been established, and is in accord with the electronic level scheme of R S Mulliken (*Phys Rev*, **32**, p 216, 1928)

That active nitrogen is a molecule of nitrogen in this metastable condition is further supported by some recent experiments which we have carried out on the life of active nitrogen. This can be varied within wide and indefinite limits simply by the regulation of pressure, everything else remaining constant For a short life of the order of 0 1 sec the experiment is best performed by drawing our nitrogen at about 7 to 8 mm pressure from a region of condensed discharge For very low pressures, say 0 03 mm of mercury, the active nitrogen is formed with an electrodeless discharge and its life may be abnormally extended to several minutes It has been clearly observed by us that for any given specimen of nitrogen the life of active nitrogen increases continuously and regularly with the decrease of pressure This is a strong evidence for the presence of metastable molecules

In another series of experiments we have produced the infra red lines of nitrogen belonging to the electronic configurations $2L_1M_1 \longleftarrow 2L_2M_2$ by exciting first nitrogen and then active nitrogen with uncondensed discharge under exactly identical conditions No change in the relative intensity of lines was observed, which points to the conclusion that there is no appreciable density of atoms present in active nitrogen

P K KICHLU
S BASU

Department of Physics,
Science College, Patna, Mar 27

DR KICHLU and Mr Basu seem to have overlooked an early investigation (*Proc Roy Soc*, A, vol 86, p 264), in which it is shown that a given sample of active nitrogen, made active at a low density by the electrodeless discharge, can, after intervals up to several minutes, be made momentarily very bright by compression

This experiment seems to cover what Dr Kichlu and Mr Basu have observed, with the additional point that compression causes the active gas to give up its energy rapidly *in the form of light* (α bands)

This seems clearly to prove that collisions of some kind are the occasion of the emission of α bands (1st positive nitrogen bands)

I am not sure if I understand the views of the authors rightly But the level which Mulliken concludes is metastable is the lower level concerned in the emission of the α bands It is not clear to me how the metastability of this level helps us to understand how the gas remains for a long time loaded with the energy necessary for the emission of α bands, which involve a level several volts higher

RAYLEIGH

Terling Place,
Chelmsford, Essex, April 24

Properties of the Terms of the Helium Molecule

IF in a diatomic molecule the influence of the internuclear axis on the valence electron is strong compared with the influence of the nuclear rotation (case I), the component σ, along that axis of the vector l representing the moment of momentum of the electron, is, as was shown by Hund, a whole multiple of $h/2\pi$, and the rotational energy is, apart from a constant, proportional to $j(j+1)$ (j = total moment of momentum of the molecule) If, on the other hand, the influence of the rotation is predominant (case II), l is quantised with respect to the axis of rotation, and if its component along this axis is ρ, the rotational energy is proportional to $(j-\rho)(j-\rho+1)$ The energy in the intermediate case is a complicated function of j, and has been calculated approximately for simple cases by Hill and van Vleck (*Phys Rev*, **32**, p 250, 1928)

Case I is realised in most molecules The electronic spin usually complicates the problem In the helium band spectrum we can observe, as already shown in a qualitative way by Weizel (*Zeit f Phys*, **52**, p 175, 1928), all the different stages of transition between the cases I and II The terms which are produced by the different orientations of orbits with $l = 2$ (δ complex) are of special interest The bands which originate from a combination of this complex with the $2p$ level show a very anomalous behaviour both with respect to the position of the lines and to their intensities All their properties can, however, be understood, if one follows the transition from case I to case II The connexion between the theoretical and empirical term symbols and the values of σ and ρ is given below

Term	Case I	$\pi\Sigma_b$	$\pi\Pi_a$	$\pi\Pi_b$	$\delta\Sigma_a$	$\delta\Pi_b$	$\delta\Pi_a$	$\delta\Delta_b$	$\delta\Delta_a$
	Case II	π_1	π_0	π_{-1}	δ_2	δ_1	δ_0	δ_{-1}	δ_{-2}
Empirical designation			p_a	p_b	z	x	y	d_b	d_a
σ		0	1	1	0	1	1	2	2
ρ		1	0	−1	2	1	0	−1	−2

The connexion of the Greek letters used in designating the terms with the values of l and σ is evident (Mulliken uses S, P, D instead of Σ, Π, Δ) In the He_2 molecule only the terms which are antisymmetric in the nuclei are present They can only have odd values of $j-\rho$ Therefore, also in case I, j is odd for even values of ρ (index a) and even for odd ρ (index b)

In the 3δ complex, case I is realised for small values of j This means we must use the σ classification and have the normal type of transitions studied especially by Mulliken We have here $\Sigma \dashrightarrow \Pi$, P, Q, and R branches, $\Pi \longrightarrow \Pi$ only P and R branches, and $\Delta \dashrightarrow \Pi$, P, Q, and R branches That is in exact agreement with the observations For larger values of j the coupling of l with the internuclear axis becomes looser, which is shown by a shift in the energy levels and the appearance of Q branches in the $\Pi \longrightarrow \Pi$ band At the same time the P branch of the $\Sigma \dashrightarrow \Pi$ band disappears and the Q branch becomes much weaker The behaviour of the separate energy levels is represented by formulæ obtained in the same way as those of Hill and van Vleck

The $2p$ 4δ complex, which is also completely known, shows that the 4δ terms are also for small values of j in the transition stage between cases I and II Whereas the energy of the separate terms becomes a complicated function of j, the theory shows that the mean values of δ_1 and δ_{-1} and those of δ_2, δ_0, and δ_{-2} behave like the energy of a $\sigma\Sigma$ term which can always be represented by a simple quadratic expression in j That is in excellent agreement with the observations, and the molecular constants can easily be calculated in this way

For the 5δ and 6δ complexes the observational data are not yet entirely complete But the existing data show that stage II is reached already for very small values of j The anomalous energy values have disappeared The nuclear moment of momentum is again an integration constant and ought therefore only to change 0 and ± 1 in a transition That means that for the combination of a δ_ρ term with the $2p$ level which is in stage I, we get the following branches:

Initial term	δ_2	δ_1	δ_0	δ_{-1}	δ_{-2}
Branches	R	R, Q	R, Q, P	Q, P	P
Appearance	P	Q, P	R, Q, P	R, Q	R

So far as the data permit this to be tested, it was found to be in agreement with the facts

The transition stage of the π-terms is analogous, though much simpler, owing to the fact that there are only three of them, and because the one with $\sigma = 1$

and $\rho = 0$ ($\pi \Pi_e$, the term which gives the Q branches in the $s \to p$ bands) behaves like a $\sigma\Sigma$ term

The constants $B = \frac{h}{8\pi^2 I}$ and A, which expresses the degree of coupling of the vector l to the internuclear axis, for the most important terms are

	2π	3π	4π	3δ	4δ	Par 3δ
A	8890	2971	1482	165	75 06	132
B	7 336	7 173	7 130	7 072	7 088	7 079

For the degree of accuracy, way of calculating, etc, I must refer to the full paper which will be published elsewhere and will contain all the details The ideas expressed in the present note have also proved fruitful for the understanding of the spectrum of the hydrogen molecule

G H DIEKE

Natuurkundig Laboratorium der Rijks Universiteit, Groningen

Elastic Collisions of Electrons with Helium

IN view of the recent experiments of Dymond and Watson on the scattering of electrons in helium (*Proc Roy Soc*, vol 122, p 571), it has been of interest to work out the scattering predicted by the wave mechanics The method used is that of Born (*Gottinger Nachrichten* p 146, 1926) and involves two separate approximations In the first place, we neglect the polarisation of the atom by the incident

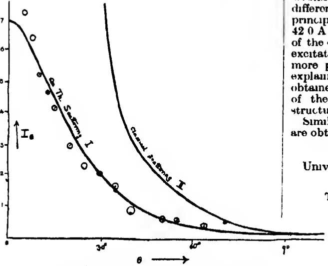

FIG 1 —Elastic scattering of 210-volt electrons by helium Experimental readings fitted at 30° are indicated by ○

electron, the atom being treated as an electrostatic centre of force We have used the field calculated for helium by Hartree (*Proc Camb Phil Soc*, vol 24, p 111) Secondly, we have calculated only the first approximation of Born, which is sufficient only if the de Broglie wave length of the incident electrons is large compared to the classical distance of closest approach Neither approximation will introduce a serious error if the energy of the incident electrons is large compared to the ionisation energy of the atom For 200 volt electrons the error should not be greater than about 20 per cent

Fig 1 shows the variation of scattering with angle to be expected for elastic collisions with 210 volt electrons I_θ is the scattering per unit solid angle Curve I gives the quantum theory scattering, and curve II the classical scattering by the Hartree field of the atom The two curves lie close together for large angles, where the scattering is mainly nuclear For small angles there is a marked difference the classical I_θ becoming infinite for θ equal to zero, as the following table suggests

θ	3 3°	5 7°	19°	30°	44
I_θ (classical)	190	54	2 1	0 81	0 26

It is not true, as is often stated, that the scattering integrated over all angles is the same both classically and on the quantum theory

The results of Dymond give relative scattering only, and we have therefore fitted our curve and his readings at 30° Considering the approximate nature of our calculations, the agreement is as good as can be expected It is obvious that the experimental readings could not be fitted to the classical theory curve

An account of these calculations will be published shortly, in which it is hoped to consider also inelastic collisions

N F MOTT

St John's College, Cambridge

Densitometric Measurements of the K-α Line of Carbon

(BY CABLE)

DENSITOMETRIC measurements of the $K\alpha$ line of carbon in three orders obtained with a grating having twelve hundred lines per millimetre show distinct, clearly measurable separation of components in the second and third orders, wave lengths checking in different orders and on different plates There are four principal components in the main line at 44 2 A, 42 0 A, 45 4 A, and 46 15 A The relative intensities of the components apparently depend on conditions of excitation, some of the longer components becoming more prominent at higher driving potentials, thus explaining the divergence of wave length values obtained by other observers in the third order Some of these components apparently have a doublet structure

Similar but broad and more complex separations are obtained in boron $K\alpha$

C B BAZZONI
FAUST
WEATHERBY

University, Pennsylvania, April 24

The Assembling of Male Moths due to the Sense of Smell

DR ERNEST WARREN, in his interesting letter published in NATURE of Feb 23 (p 278), suggests that the assembling of male moths around the female is evidence for the existence of "recondite influences"

It is, however, clear that the flight of the males is stimulated and directed by air borne odoriferous particles, which, however have no effect upon the human olfactory sense If a virgin female of certain moths, such as the Oak Egger, be carried in a closed box, males are not attracted, but they begin to assemble directly the cover is taken off Furthermore, the box itself may continue to attract for some days after the female has been removed Porous substances continue to be attractive longer than dense ones Such 'assembling' males possess wide spreading antennæ, adapted to comb the air during their rapid, characteristic flight, which is such as to test a large cross section as they proceed Some of the detailed evidence that the attraction is due to scent has been brought together in the *Proceedings of the Entomological Society of London*, vol ii 1927–28, pp 75 82

EDWARD B POULTON

Oxford, Mar. 29

Physics in Relation to Oil Finding[1]

By Prof A O RANKINE

IF a time graph is plotted, with the intervals between the instant of explosion and that of *initial* disturbance of the seismograph as ordinates, and the distances between explosion and seismograph

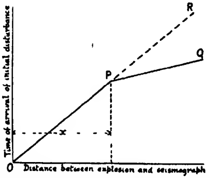

FIG 2 —Time distance graph corresponding to Fig 1 x is the distance at which direct and indirect disturbances arrive synchronously

as abscissæ as in Fig 2, it will display a break (at P) where the times of arrival of direct and indirect disturbances are equal Actually the distance x for time equality is related to the depth of the interface by the relation

$$\frac{h}{x}=\frac{1-\sin\theta_e}{2\cos\theta_e}$$

Moreover, the slope of OP, which corresponds to the direct disturbance, is proportional to $1/V_1$, while the slope PQ, which relates to the indirect disturbance, is proportional to $1/V_2$ Thus $\sin\theta_e = V_1/V_2 =$ (slope of PQ)/(slope of OP) Hence θ_e is determined, and its insertion in the above equation, together with the value of x read from the graph, enables the depth h of the interface to be calculated

Owing to its relatively large magnitude, it is possible to recognise on the seismograms the arrival of the direct disturbance even when it reaches the seismograph *after* the indirect disturbance This corresponds to the dotted portion PR of the curve, or OP produced

This simple case is merely an illustration Many others have been worked out, such as those corresponding to more than one stratum, sloping strata, or interfaces which abruptly change depth To deal with these here would lead us too far In all cases the procedure has to be the assumption of various possible underground structures until one is found which by calculation agrees with the time graphs actually obtained For this purpose it is frequently necessary to multiply observations by changing the position of the explosion point and the direction of the line of observation The accumulation of field data over various structures also obviously facilitates the recognition of similar structures in subsequent surveys

It is only possible to deal very briefly with field procedure Where, as often happens, the salt-domes or limestone anticlines are deeply buried, large charges must be exploded because of the long ranges which must be covered to reach and pass beyond the point of time equality—an essential condition if the depth is to be determined Consequently it is economical to multiply the number of seismographs used rather than the explosions For celerity of survey the seismographs must be readily portable and easily set up in their new positions In the early days of this work the instant of explosion (necessary for the calculations) was deduced from the position of the air borne

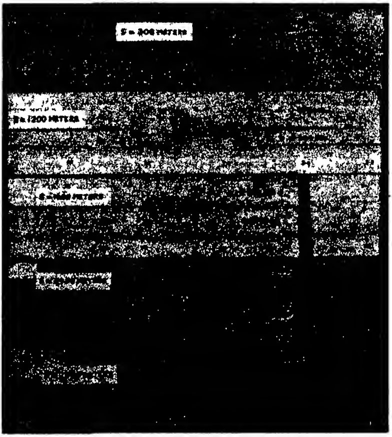

FIG 3 —Five seismograms obtained on an observation line over a salt dome Dots at bottom of each are made by time marker, interval being $\frac{1}{10}$ second

[1] Continued from p 686

disturbance on the seismogram, assuming the value of the velocity of sound in air This in practice is often the largest effect recorded, but it arrives much later than the earth borne vibrations This method, which is rather inaccurate on account of the wind and temperature corrections, has now been superseded by including with the recorder an oscillograph which places on the record a wireless signal actuated by the breaking of an electric circuit by the explosion itself The recorder includes a time marker which enables the transmission times to be estimated with sufficient accuracy Photographic recording is ordinarily used I have seen a troop of observers of the Geophysical Company, Ltd, operating this system in the Anglo Persian oil fields, and have nothing but admiration for the celerity and efficiency with which the field work is carried out

Through the courtesy of the Geophysical Company, Ltd, it is possible now to publish for the first time a group of five seismograms obtained with Mintrop seismographs (which record vertical movements of the earth's surface) over a salt dome These are shown in Fig 3, and exhibit the various effects to which reference has been already made Each shows (at the point O) the wireless signal of the explosion, and the final effect of the air borne wave, in some cases so large as to make the detail

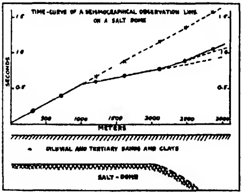

Fig 4 —Time-distance graph corresponding to seismograms in Fig 3

of the trace invisible In the last three records a piece has been cut out so as to bring this effect within the scope of the diagram The earth-borne disturbance, which lies between the wireless signal and the air wave, changes in type as the distance is increased. The indirect disturbance, which is not visible in the first seismogram at 308 m, makes its first appearance in the second at 1200 m, as a small vibration preceding the much larger direct disturbance In the next two, at 1600 m and 2450 m, the time interval between the indirect and direct disturbance has increased progressively in magnitude, while in the last, at 2850 m, the time difference is approximately the same as in the one just previous

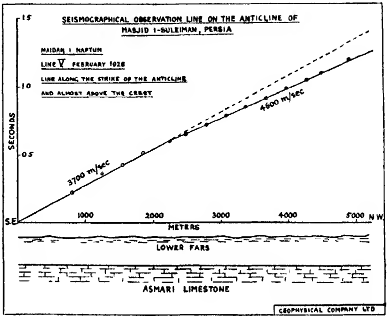

Fig 5

The time graph in Fig 4, which includes points from other seismograms besides those shown in Fig 3, exhibits the results graphically It shows unmistakably, at a range of about 1000 metres, a discontinuity of the kind mentioned in an earlier paragraph, and the two different slopes before and after this point There is displayed besides the ultimate tendency of the curve to resume its initial slope—a feature known from theoretical considerations probably to signify a dipping of the interface The depth, and roughly the shape and location of the edge of the salt-dome have thus been deducible, and are shown in the lower part of the diagram

Time graphs of the same general character relating to the great limestone anticline, from which most of the Anglo-Persian oil is at present drawn, are shown in Figs 5 and 6 The survey in this region was carried out for the Anglo-Persian Oil Company, Ltd, by the Geophysical Company, Ltd, and really constituted a test of the efficacy of the seismic method over a region where the general features of the limestone structure were already known as a result of extensive drilling Fig. 5 relates to a direction of observation parallel to the long axis of the anticline and Fig 6 to a traverse across it The conditions were much less favourable than over salt-domes, owing to the depth of the limestone and to the relatively small difference of velocity as between the limestone and the Lower Fars with which it is covered This is indicated in the time graphs by the smallness of the changes of

slope in the curves Nevertheless, the method, which had previously been applied extensively and successfully to the location of salt domes in Texas, proved of value in Persia also, the limestone depths being measured to an accuracy of 10 to 15 per cent There are, therefore, good grounds for confidence that the surveys being carried out by the Geophysical Company, Ltd, on similar structures of unknown shape in other regions of Persia and in Iraq will provide the data required for successful drilling for oil

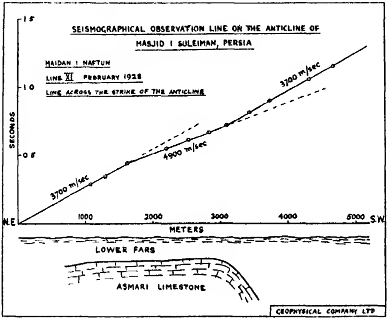

FIG 6

For descriptions of portable seismographs the reader must be referred elsewhere, for example to the recently published translation of Dr Ambronn's book,[8] which contains the original references

[8] *Elements of Geophysics* By Dr Richard Ambronn translated by Margaret C Cobb (London McGraw Hill Publishing Co, Ltd)

Mintrop's seismograph, with which most of the seismic surveying has been done, is one in which the magnification of the earth's movement is secured partly mechanically and partly optically There are others of the same type, notably Schweydar's, which records also horizontal movements Another type employs electrical magnification, as in Dowling's and Ambronn's instruments It is doubtful whether any of them imitates precisely the movements of the earth's surface, but so long as it is merely a question of determining the instant of first arrival of the disturbance, this is of no great importance It is nevertheless worthy of note that the production of an exact recorder will open new lines of attack on the problem, such as the determination of the angles at which the disturbances arrive at the earth's surface

Progress is being made in the gravimetric and seismic methods of survey, both as regards improvements of the instruments themselves and the technique of procedure in the field and in interpretation In this matter Great Britain is much behind-hand, and it is hoped that this article may contribute to the stimulation of that interest which is essential to progress

I desire to express my thanks to the Anglo-Persian Oil Company, Ltd, and to the Geophysical Company, Ltd, for approving and facilitating the publication of this article I am specially indebted in this respect to Prof Mintrop, and to Mr Ernest H Neville and Dr Schmidt of the latter Company

The Centenaries of Davy and Young

IN the National Portrait Gallery hangs the well known composite portrait group of eminent British men of science who were alive in 1807–8, the group being shown assembled in the Library of the Royal Institution There are forty eight portraits in all, including those of Banks, Watt, Rumford, Jenner, Herschel, Cavendish, Telford, Trevithick, Wollaston, Dalton, Davy, and Young The oldest represented in the group was Matthew Boulton, the partner of Watt, who was born in 1728, while the youngest was Davy, born just fifty years later, in December 1778

No more appropriate setting could have been found at that time for such a group, for though at its birth the Royal Institution had for its sponsors many notable men of the day, its infancy had been a somewhat precarious one, and it was mainly through the talents of Davy, then probably at the height of his powers, that it had been rescued from the uncertainties which had threatened its very existence It had been raised to a foremost position among scientific institutions, where not only the learned, but also the fashionable and the great, gathered to see the striking experiments of Davy and to listen to his brilliant discourses from which we are told Coleridge increased his stock of metaphors

Founded in 1799 through the exertions of Rumford, the Royal Institution had already counted among its first professors Garnett and Young, but it was the lectures of Davy which marked the beginning of the popularity it has since enjoyed and the reign of discovery with which its name is linked After Davy came Brande, Faraday, Tyndall, Dewar, and others, and in "Britain's Heritage of Science" we are told "there is no

building in the world associated with so many classical and revolutionising researches as that in which the Royal Institution is housed"

If the setting for this remarkable group invites our approbation, no less does the date of its execution appeal to our sense of historic fitness The early years of the still young century had been full of promise, and though owing to the ambition of Napoleon few nations were free from the threat of war, scientific and industrial development was proceeding apace, and the very names of Cavendish, of Herschel, of Watt and of Trevithick recall the pioneering work and the planting of the seed from which our later harvests have come At home and abroad, science in 1807 was engaging some of the keenest minds The guillotine, it is true, had robbed France of her greatest chemist, but she still counted among her veterans, Laplace and Lagrange, Legendre and Coulomb, while following in their footsteps came Fourier, Biot, Ampère, Malus, Arago, and Fresnel

As in France, so in Europe generally, science and invention were bearing good fruit Astronomy had been enriched by the discovery of Ceres, Pallas, Juno, and Vesta, Volta's great invention of the electric battery was being applied in a hundred experiments, Chladni had made the world his debtor by the publication of his work on acoustics, while Oersted had begun his work at Copenhagen, where he was destined to make his great discovery of electro magnetism To the particular years 1807 and 1808 belong the publication by Thomson of the atomic theory of Dalton, the publication of Young's "Lectures on Natural Philosophy", and the memorable experiments of Davy leading to the isolation of sodium and potassium

However interesting a review of the science of that time may be, our immediate attention is naturally directed to the careers of Davy and Young, both of whom died in May 1829, a hundred years ago, Young passing away on May 10 and Davy on May 29, Young being then but fifty five and Davy only fifty years of age Strangely unlike in temperament, in character, and in their reaction to the buffets and rewards of life, they yet present many interesting parallels as well as contrasts Even Galton would, perhaps, have found it hard to determine the influence of heredity on their careers, for Davy was but the son of a woodcarver of Cornwall, and Young the son of a Quaker landowner of Somerset In neither instance, also, did early training have much to do with their subsequent successes The astonishing precocity of Young was equal to that of a Macaulay or a Rowan Hamilton, and as a boy of fourteen years of age he was acquainted with Latin, Greek, French, Italian, Hebrew, Persian, and Arabic Davy had a mind equally alert and a memory equally tenacious, but he enjoyed fewer advantages than Young, and it was to a Quaker saddler friend and a self appointed guardian that he owed the encouragement and assistance without which, perhaps, his genius might have led him to less congenial pursuits Young was the senior of Davy by five years, and while Davy was serving his apprenticeship to the Penzance apothecary and surgeon, Borlase Young was leisurely following his academic course in medicine at Edinburgh, Göttingen, and Cambridge, where his learning led to his being known as "Phenomenon Young"

It was in 1801 that the paths of these two extraordinary men met, the older one becoming the professor of natural philosophy and the younger the professor of chemistry in the newly founded Royal Institution Davy's first lecture was given on April 25, 1801, Young's first lecture on Jan 20, 1802, but whereas we are told Young found "the number of his attendants diminish daily, and for no other reason than that he adopted too severe and didactic a style", Davy filled the theatre to overflowing, where "his youth, his simplicity, his natural eloquence, his chemical knowledge, his happy illustrations and well conducted experiments excited universal attention and unbounded applause"

Of the details of the work of these illustrious investigators many accounts have been given His experiments with nitrous oxide, his isolation of sodium and potassium and other elements, and his invention of the miner's safety lamp are but a few of the outstanding achievements of Davy, whose name was as familiar in France and Italy as it was in England His invention of the safety lamp he made a free gift of to mankind, and the silver plate presented to him by the colliery owners in recognition of his work was long since sold and used for founding the Davy Medal of the Royal Society Young's work illustrates the versatility of his rare mind His most notable contributions to science were concerned with optics, the strength of materials, and elasticity The first definitions of 'energy' as we understand it and of 'Young's modulus' are to be found in his "Lectures" His views and discoveries in light were fundamental, and he has been called "the founder of physiological optics" Of Young, Helmholtz said 'He was one of the most clear sighted of men who ever lived, but he had the misfortune to be too greatly superior in sagacity to his contemporaries They gazed at him in astonishment, but could not always follow the bold flights of his intellect"

Known widely for their writings, their lectures, their researches, and discoveries, Young and Davy are also remembered for the work they did in connexion with societies, committees, and institutions Both were foreign associates of the Paris Academy of Sciences, both held secretaryships of the Royal Society, of which Davy was the twenty fourth president, while Young was long physician to St George's Hospital The grave of Young is at Farnborough, Kent, that of Davy in a cemetery outside the city of Geneva There is a statue of Davy at Penzance, a marble bust of Young in the Shire Hall, Taunton, while each is commemorated by a memorial tablet on the walls of St Andrew's Chapel, Westminster Abbey Such memorials, however, may crumble and perish, but the work of Young and Davy will endure for ever, for as Davy said when presenting the Copley Medal to Arago "Science, like Nature, to which it belongs, is neither limited by time or space It belongs to the world, and is of no country and no age"

Landscape at the Royal Academy

By Dr VAUGHAN CORNISH

THE representation of the vibrant effect of sheer sunlight is a relatively modern achievement in painting which has, however passed through the experimental stage, and is well given in Mr H H La Thangue's two pictures, Provençal Workers (34) and A Provençal Forecourt (488), and vibrance is well combined with the complementary colouring of sunlight and shadow on the white walls of the Farm near Sospel by Mr St Clair Marston (614) It is, however, from our own Cornish coast that Mr Julius Olsson chooses his examples of moon light on the waters the acme of contrast in tone in an almost monochromatic scene which never fails to touch the chords of emotion The subjects are St Anthony Light (176) and Herring Fleet St Ives (500)

Sunlight and shadow on the waves are rendered in George F Bradshaw's At Sea (1) and on the irregular surface of snow by Donald H Floyd Sunshine after Snow (131) Circumambient colour of sea and sky is effectively accentuated by its concentration and massing on hull and sails in Mr Arthur J W Burgess's Gipsies of the Deep (357) and Pleasure Afloat (281) For the blue depths of atmospheric colour our painters have relied upon the mountain background, as in Lakeside (571) by Sydney V North and in Mr E L Lawrenson's picture of the remote Achill (153) where as in Skye, some peculiarity of insular climate beside the western ocean dyes the distant hills in deepest purple

For catching the moods of the mountains as determined by weather and season, a very mirror of the moods of man, the method of water colour has advantages and the enlarged space now given to the water colours at Burlington House is there fore welcome to the student of Nature, as is also the allotment of a fine spacious gallery to the drawings, engravings, and etchings, among which are many interesting landscapes Mr Alfred Hartley's aquatints, A Storm on the Alps (1082) and Morning Haze on a Swiss Lake (1070), are the reward of those who watch and wait among the mountains In Mr Percival Gaskell's aquatint, On the Lake of Thun (1130), looking west across the water towards the Stockhorn range the suffusion of afternoon light enables the artist to unite the boldness of the peaks and the repose of the lake, the combination which so greatly contributes to the delights of residence in Alpine lakeland In Mr B Eyre Walker's aquatints, October Snow, Winder mere (1126), and the tiny Autumn Snow on Coniston (1156), we are pleasantly reminded of the beautiful aspect of the English Lake District, when the peaks are emphasised by snow caps, while Sir D Y Cameron's wash drawing Cluanie (1034) indicates admirably the way in which the re-entrant line of the lake shore, stronger in tone than the skyline, imparts an appearance of ordered grouping to the surrounding mountains

For landscapes which derive their motive in the cyclopæan masonry of rock structure, we must return to the oil paintings In Pordenick, Land's End, by Charles W S Naper, the strongly jointed rock has a pattern of vertical and horizontal lines so easy for the eye to grasp that the strength of the cliff in no way impairs the sense of repose imparted by the calm sea from which it rises sheer An effect not altogether dissimilar may be seen where church towers rise above the flat expanse of the Fen Country Mr John H Willis's In the Nant Ffrancon Pass (403), one of the few large landscapes, is a fine study of a rhythm of rock structure more exciting to the eye, spiked pyramidal The colouring of this landscape, whether determined by preference or the chances of the season, is not that which best concords with the forms of this district, but we can find satisfaction in Miss Judith Ackland's Snowdon by the Pen y Gwryd Track (647), in which tone and colour convey the solemnity of Snowdonia Other artists seek, I infer, to enhance the abstract quality of strength in mountains by stripping them of atmosphere so that the whole structure, including the serrated skyline in the distance, has a texture comparable to that of a rocky foreground Such appears to be the intention in The Pillars of Heaven (284) and Mountains of Murcia (611) by Mr Guy Kortright, and a somewhat similar treatment is found in The Alps from Sallanches by Mr R M Hughes (160) These studies are in full daylight If it be permitted to a fellow student of mountain beauty, though not a fellow artist, to offer a suggestion, I would venture to cite my experience that in certain types of weather the hours of dawn show the high mountains in a strength of tone rivalling lunar landscapes combined with such conditions of colour as would assist the abstract treatment of massive effect

Among the studies of Arcadian England, there is one of special charm which is likely to escape notice on account of the fact that it is almost the smallest picture in the Exhibition, Miss Dorothy M Snow's water colour, A Sussex Farm (788) It shows that neatness of agricultural landscape which astonishes the visitor from the New World, causing him to exclaim, as I have myself heard, that " this country is a garden " The smoothly rounded lines of the topography of the southern and midland counties of England, and the rounded forms of their spreading, broad leaved trees, make difficult the task of harmonising architecture with the landscape, but in the barren and rocky lands of the Spanish *meseta*, architecture carries the forms of natural landscape to a culmination, as is shown in Mr Oliver Hall's important picture, A Spanish Bridge (86), which gains in effect from its suitable frame of black and gold Among the water colours, Mr Cecil A Hunt's Gorge of the Tagus, Toledo (764), also deals with an architectural culmination of rocky form At the present time, when controversy is so keen on the subject of styles of construction considered in relation to the amenities of the countryside, it is important that we should

(*Continued on p* 731)

Supplement to NATURE

No 3106 MAY 11, 1929

The Maintenance of Life and Irritability in Isolated Animal Tissues [1]

By Prof A V Hill, F R S

NOT infrequently one hears the view expressed that physiologists are too ready to work with isolated tissues, not willing enough to study the intact and living animal The isolated organ is said to be abnormal', its behaviour too remote from that of its previous self, in its usual environment, to throw much light upon the normal processes of life There is indeed a danger that those who work under artificially simplified conditions may, in their enthusiasm, extend their results too far the greater danger—I speak with feeling—is that their friends, and the daily Press, may do so for them If you describe how a nerve fibre maintains the electrical potential difference at its boundary by an active process involving the consumption of oxygen, you may find your name in all the newspapers, and be invited to America to raise people from the dead if you prove that chemical disintegration sets in, in a stimulated muscle deprived of oxygen, you may be charged with attempting to create a living cell (and indeed a living 'soul') in the laboratory

Realising this danger, however, appreciating that only after hard and critical thinking may the results of laboratory work under simplified conditions be applied to the graver practical problems of life, we may—in fact, we must—go forward in the confident belief that only by investigating phenomena under such simplified conditions can we really hope to understand them

Here, to the scientific mind, is in fact a definite and presumably soluble problem, that provided by 100 mgm or so of isolated muscle or nerve, capable of responding in a regular and reproducible manner to certain treatment academic—certainly so was the study of the conduction of electricity through gases—until it led to X rays and amplifying valves abnormal—if you like but still a fact, and one that presumably can be explained The irritability, the responsiveness, of this little bit of surviving tissue can be maintained, under conditions which we are beginning slowly to understand, for considerable periods and during all this time we can study the processes of life, in abnormal form if you wish, but still as phenomena, as facts, under conditions which allow us to apply the methods of physics and chemistry as we could never hope to do in the normal intact animal

Energy Exchanges in Nerve

The isolated nerve of a frog, placed in an appropriate salt solution containing oxygen, will live, or at any rate continue to function, for days We can detect its activity most readily by leaving it connected to a muscle, which will twitch when we stimulate the nerve A better method, since it involves the properties of the nerve alone, is to record the 'action current', which passes for a few thousandths of a second between electrodes placed upon its surface Another method, but more difficult to apply, is to measure the heat produced by the nerve when stimulated

For long periods the surviving nerve will show all the outward and visible signs of a response to stimulation During prolonged survival at rest it consumes oxygen and gives out carbon dioxide at 20° C about half a cubic millimetre per gram per minute, more at a high temperature, less at a low During maximal activity, due to continual stimulation, its metabolism is doubled, its oxygen consumption at 20° C is about one cubic millimetre per gram per minute It gives out corresponding heat Of this heat, only about one tenth appears during the passage of the impulse—the rest comes off slowly, during the following fifteen minutes clearly it is related to some recovery process, by which the nerve is recharged', by which its potential energy, so to speak, is restored

The fact that extra oxygen is used as the result of activity is, in a sense, easy to understand Breakdown has occurred, free energy has been liberated, and if the process is to be reversed, oxidation is necessary to supply the free energy required in the re synthesis The oxygen consumption at rest is much more difficult to comprehend Why should

[1] From the Ludwig Mond Lecture delivered at the University of Manchester on Mar 6.

an isolated tissue, doing nothing at all except continuing to exist—that is, continuing *to be ready* to respond to a stimulus—require what is in fact a considerable amount of oxygen, three quarters of its own volume per day at 20° C, three to four times its own volume at human body temperature? Energy, we may say, is required to maintain the organisation In what manner, however, is the energy being applied? What will happen if the supply of oxygen be stopped?

The last question is very readily answered by experiment The air around the nerve is replaced by pure nitrogen, and from the known diffusion constant of oxygen and the known oxygen consumption of the nerve, we can calculate that in a very few minutes not a trace of molecular oxygen is left A stimulus is applied at intervals, and the action current, or the heat, is used as a sign of activity At first no particular change occurs the nerve responds as before Long after *all* the molecular oxygen is gone, action current and heat production remain almost unaltered Even the recovery heat, which surely is of oxidative origin, is unaffected Presumably there is some source of intra molecular oxygen, or some store of hydrogen acceptor, which, for a time, can supply the energy required for recharge Gradually, however, a change comes on action current and heat diminish, and in two hours after the oxygen was removed they disappear together

The nerve, however, is not dead let oxygen in and it revives its return is gradual, much slower than the inward diffusion of the gas—the oxygen clearly has some duty to perform, some debt to pay, before the situation is cleared up The nerve asphyxiates much quicker a second time if its exposure to oxygen be cut short Indeed, by the admission of oxygen alone, complete recovery from asphyxia is not possible however long be the exposure to oxygen, subsequent asphyxia (as Gottschalk showed) is quicker than it was originally Washing the asphyxiated nerve with *oxygen free* salt solution restores it temporarily Complete restoration, however, is attained only if washing be combined with oxygen Then the nerve returns triumphantly to its full initial activity, apparently unaffected by the intervening period of asphyxia It seems as though, in the absence of oxygen, two things have happened (*a*) some metaphorical accumulators have run down and need recharging—a process which requires oxygen, and (*b*) certain abnormal substances have appeared, which cannot be removed by oxygen, but will diffuse away into surrounding salt solution

Potential Differences in Nerve

Many attempts have been made in recent years, before the latest and most successful ones, to measure the gaseous exchanges of isolated nerve Actually in the refined methods employed by Meyerhof and by Warburg, modifications of those of Barcroft, a means has long been available of making these important measurements When Downing and I succeeded at last in measuring the heat production of nerve, it seemed to us, and to Gerard who had joined us, that corresponding determinations of oxygen consumption should be carried out I wrote, therefore, to Meyerhof and asked him if Gerard could come to make these with him Meyerhof waited a day to reply his answer was, as I expected, "Of course, let Gerard come", but also, as I had not expected "es ist ausserordentlich leicht, I did it yesterday on the receipt of your letter" So Gerard went and made the experiments in Berlin At the same time Fenn was doing the same thing in his laboratory at Rochester, New York The oxygen consumed at rest, the oxygen needed for activity, and finally, the oxygen required for recovery from asphyxia, were all measured and are now tabulated for those who need to use them for their calculations

I mention these measurements partly for their own sake—as the happy ending to a long series of persistent attempts—but more particularly for a curious by product which, like many by products, is likely to prove more important than the original object An American worker, some years before, attempting to measure the carbon dioxide production of nerve, had employed a very convenient object, the limb nerve of the spider crab Reading his paper I noticed that, whereas he had stimulated the nerve for long periods, he gave no evidence that the nerve had really responded at all to his stimuli Knowing from experience of medical practical classes how often nerves do not respond to the best intentioned stimuli, I thought I had better try for myself So, being at Plymouth, where there are much bigger and better spider crabs than in America, I tried, and by good fortune a whole beautiful new field of work appeared

The experiment was a simple one A and B are two non polarisable electrodes placed upon the nerve, which for the sake of the argument we take as a single nerve fibre A is at an uninjured point, B at the cut and injured end A and B are connected to a galvanometer A difference of potential exists between A and B, the so-called injury potential, which produces what is called the 'demarca-

tion current' when it is allowed to flow through the galvanometer A is positive to B in the external circuit When we apply an induction shock to the nerve at a distant point C, the potential difference between A and B momentarily falls as the impulse passes A the current through the galvanometer diminishes we witness what is called the 'negative variation of the injury current' If we apply a succession of induction shocks at C, each produces its effect at A as its corresponding impulse goes by, and if the galvanometer be a relatively slow one, these effects are summed up, and as we continue stimulating, the galvanometer returns

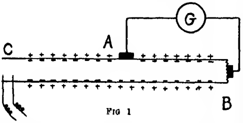

FIG 1

towards its zero, deflecting again when the series of stimuli ends Such, at any rate, is what happens in a frog's nerve The fact has been known for two generations it is demonstrated to students but curiously enough—so far as I am aware—nobody had ever tried to show it in a crab's nerve In that tissue, if stimulation be continued long enough—for a minute or two—the galvanometer does indeed move backwards during the stimulus towards its zero, recording the usual 'negative variation', but it does not return outwards again when stimulation ends

Let me pass for a moment to a fact recently established by Furusawa If a crab's nerve be kept in air in a moist chamber, the difference of potential between A and B is maintained for long periods If, however, the air be replaced by pure nitrogen, the difference of potential between A and B gradually diminishes On introducing air again it rises to its original value, not immediately but in an hour or so Clearly, oxygen is being used to maintain a potential difference somewhere within the nerve Where can this potential difference be other than at the surface of the fibre itself? At the cut end the electrode is in contact with the naked protoplasm of the cell at the uninjured point the electrode is in contact with the outside of the membrane surrounding the tissue We must imagine that the injury potential is really the difference of potential across the membrane of the nerve fibre, the contents of the fibre between B and A simply acting as a continuation of electrode B Apparently, then, Furusawa's observation shows that the potential difference existing across the membrane bounding the nerve is maintained by oxidation, and gradually 'runs down' if oxidation be prohibited

Picture the passage of the impulse along the nerve as being momentarily accompanied by a breakdown, or maybe a short circuit, of the membrane, perhaps by a change of permeability allowing local currents to run and so to propagate the impulse Thinking of the membrane as similar to an accumulator of small capacity, a series of such momentary short circuits might 'depolarise' it, so that by stimulation we might effect a decrease in the observed injury potential Now Levin found, and Furusawa has confirmed the fact, that a prolonged stimulus applied at C causes a return of the galvanometer towards its zero, which is not followed by a deflection outwards again when the stimulus ends Furusawa, moreover, has proved that if local fatigue at the point of stimulation be avoided by employing, in rapid succession, a series of such points, the nerve can be *completely depolarised by activity* The accumulator' which lies along the bounding membrane of the nerve fibre can, it seems, be caused to run down completely by prolonged activity Let us now withdraw the stimulus and wait If the nerve be in air, the potential difference between A and B gradually rises again until finally it attains its original value This is the recovery process to which I referred earlier If, however, the nerve be in nitrogen, it remains depolarised and further activity is impossible The potential difference existing across the boundary of the living cell is not only maintained but also restored by an active process of oxidation

Osmotic Differences in the Egg

In a recent paper from Holland by J Straub, an investigation has been described of the difference of salt concentration, and of freezing point, between the white and the yolk of an egg It appears that, in the living fresh egg, there is an appreciably higher concentration of potassium, sodium, chlorine, and lactate ions in the yolk, and an excess lowering of freezing point of about 0 15° C In preserved eggs this difference is much less The membrane surrounding the yolk is apparently freely permeable to water, even in its live condition, and the difference of freezing point on the two sides is much too large to be accounted for by any such effect as that of the Donnan equilibrium A difference of freezing-point of 0 15° would correspond to a difference of pressure of 1 8 atmospheres, and it is inconceivable

that a thin membrane so extensive as that surrounding the yolk could possibly stand a pressure such as this

It is difficult to resist the conclusion that the existence side by side of white and yolk cannot be regarded as a thermodynamic equilibrium, and Straub suggests that the difference of concentration on the two sides of the membrane is maintained by an active process of oxidation It is known that oxidation occurs in the living egg, and, according to a rough calculation, the amount of energy supplied thereby is ample to account for any osmotic work that would have to be performed to maintain, against diffusion, the observed concentration differences It is suggested that the observed inequalities in concentration and in freezing point must be due to some active life process, and the author discusses an electrical scheme for the employment of the energy obtained by oxidation in the egg He supposes that the membrane acts as a galvanic oxidation element for glucose, and that the difference of potential so set up across the membrane results in the transfer, against diffusion, of the various positive ions in question Such a galvanic battery existing across the membrane, together with differences in permeability, might be a sufficient explanation of the inequalities observed A large number of physiological phenomena would be more intelligible were we able to suppose that oxidation at the surface of a cell is largely employed in maintaining the osmotic and other differences that exist between the outside and the interior

Energy Exchanges in Muscle

In isolated muscle it has long been known that oxygen is necessary for the preservation of the excitable state A muscle left at rest in oxygenated salt solution maintains its condition for long periods if it be thin enough for the relatively slow process of diffusion to supply it adequately with that gas A resting muscle uses oxygen continuously at a rate depending on the temperature at 20° C this is about 0 7 cubic millimetre per gram per minute probably this process of oxidation at rest supplies the energy necessary in order to maintain the complex dynamic equilibrium of the living material in a steady state The known diffusion constant of oxygen through muscle, as found by Krogh, and the rate of its consumption, allow us to calculate that a thin sartorius muscle of a frog can easily remain in a steady state in oxygen just so long as combustible material is available The isolated muscle at 20° C uses about its own volume of oxygen per day and if it contains 1 per cent of glycogen this form of fuel alone should be sufficient, at that rate of oxidation, for some eight days Dissected aseptically and suspended at rest in a suitable salt solution a frog's sartorius will, in fact, if supplied with oxygen, function for a week or more

Deprived of oxygen, such a muscle produces lactic acid from its glycogen, the glycogen breaking down in this case about five times as fast as it did in oxygen If the lactic acid be able to diffuse away, as is the case when the muscle is suspended in oxygen free salt solution, the muscle lasts for a day or two, responding to a test stimulus at any time within that period finally, however, its excitability vanishes with the disappearance of its store of carbohydrate It may remain longer if glucose be included in the salt solution Apparently, if oxygen be not available, the breakdown of carbohydrate into lactic acid can replace the oxidation of carbohydrate as a source of energy Presumably, therefore, in the absence of oxygen, the formation of lactic acid is the process which supplies the free energy by which the dynamic equilibrium is maintained, by which, so to speak, the accumulators are kept charged

The term 'free energy', used in this connexion, should be understood in its strict thermodynamic sense It is interesting and important, as Burk has recently done, to calculate the free energy of the reaction by which, in living tissue, glycogen is broken down into sodium lactate We consider the whole process, dissolved glycogen transformed in the buffered alkaline medium of the muscle into dissolved sodium lactate Owing to the difference in chemical structure between the lactic acid and the glucose molecule, namely, in the ratio of the number of carbon atoms to the number of carbonyl oxygens, there is a considerable amount of free energy available in this breakdown, about 400 calories per gram of glycogen transformed For this reason, presumably, Nature has selected this particular reaction as the means of providing, in the absence of oxygen, the free energy required, either for doing work, or for maintaining (against diffusion and similar irreversible processes) the osmotic and other differences existing during life at the boundaries and other interfaces of the cell The free energy of the oxidation of glycogen is of course greater than that of its splitting to lactic acid it is about 4000 calories per gram If oxygen be absent a given process requires, let us say, 1 gram of glycogen to be broken down to lactic acid, yielding 400 calories of free energy the same process, if oxygen be present, requires only one fifth of a gram of glycogen to be oxidised, yielding 800 calories of free

energy 400 of the latter are wasted, apparently, in the recovery process

If, as I said, lactic acid is able to diffuse away, the muscle can continue to function until all its carbohydrate store is spent If, however, it be suspended in nitrogen and not in salt solution, its lactic acid cannot escape and the end comes on much earlier At 20° C in nitrogen a muscle produces about four millionths of its weight of lactic acid every minute about 0 3 per cent in 12 hours At this stage the increase in hydrogen ion concentration due to the accumulating acid renders the muscle completely inexcitable in less than 24 hours it attains the so called lactic acid maximum and passes into *rigor mortis*

The same processes can be observed to occur more rapidly when activity due to stimulation is substituted for resting survival A muscle subjected to a series of maximal induction shocks in nitrogen fails when it has given some 400 twitches, when its lactic acid concentration has reached about 0 25 per cent Suspended in oxygen free salt solution and stimulated with a frequency low enough to allow its lactic acid to escape by diffusion, it can give several times as many twitches (as my friend Kupalov has recently shown), and will continue until practically all its carbohydrate has been broken down, suspended in oxygen, or in oxygenated salt solution, it can give several thousand twitches and maintain its activity until all its carbohydrate is oxidised Moreover, as is now well known, if it be fatigued in nitrogen, and then allowed to recover in oxygen, its lactic acid vanishes and four fifths of the corresponding amount of glycogen reappears The free energy required for the reaction

$$\text{Lactate} \rightarrow \text{glycogen}$$

is provided by the oxidation of a fraction (about one fifth) of the lactic acid How this synthesis occurs, and what the chemical nature of its mechanism is, are not known but it undoubtedly does occur, and not only in muscle but also in practically every organ and tissue examined

The work of Warburg on the metabolism of tumour and other tissue is a highly important product of these studies originally conducted on muscle and earlier, in another form, by Pasteur on yeast It seems that nearly every kind of animal tissue employs the lactic acid breakdown, when deprived of oxygen, as the source of the free energy required for the maintenance—against irreversible processes—of its steady living state and that certain types of tissue, particularly those found in malignant growths, actually prefer the lactic acid mechanism and may be relatively incapable of employing that of oxidation

There is no reason to believe that when oxygen is present the processes at work are other than the sum, or the resultant, of these two The free energy of the lactic acid breakdown is apparently the source of the mechanical energy liberated by muscle, alike in the presence and in the absence of oxygen In the former case, however, a slow recovery process ensues, in which—perhaps under the action of a galvanic combustion element, as suggested by Straub for the case of the hen's egg—the lactic acid formed in the initial process is re formed into its precursor glycogen Moreover, the processes of resting survival and of activity are so similar that there appear to be strong grounds for supposing that, at rest also, the primary mechanism in which free energy is liberated (to counteract irreversible processes which lead finally to chaos and death) is that of lactic acid formation from carbohydrate

It is not a wild extrapolation from this, and from the work of Warburg, to conclude that the same is true in all animal tissues The living cell is a complex organised system of enzymes, interfaces, potential and osmotic differences, chemical substances infinitely improbable in the thermodynamic sense, and yet existing in a steady state so long as free energy is available to maintain the organisation The free energy of the carbohydrate-lactic acid breakdown is apparently the *sine qua non* of this maintenance, the common factor in the organisation of living animal cells The primary function of oxidation is the reversal of this breakdown

Reversible Inexcitability in Muscle

All who have worked with isolated muscles have found—alas, too often—that these may 'die' without apparent cause and spoil their experiments They do it more at some seasons than at others, often for weeks on end some muscles are worse in this respect than others and if we have not attributed it to the machinations of the devil (physiology leads many of us to a belief in that gentleman) we have been fain to call it fatigue', thereby expressing our ignorance of the whole matter If we knew that a muscle survived better in oxygenated salt solution than in oxygen gas, we talked about the removal of 'fatigue products' in the former, even though the muscle—being supplied with oxygen and at rest—was never fatigued at all It took two chemists, Dulière and Horton, to detect what physiologists should have recognised long ago, that a state of reversible inexcitability sets in spontaneously in isolated dissected muscles It is true that some years ago, in the biochemical laboratory at Cambridge, it was shown that the legs of frogs, kept

at a low temperature in oxygen, gradually in the course of a week or so lose their irritability, which can be restored by soaking in salt solution. It is not certain, however, that this is the same phenomenon, and in any case Dulière and Horton have demonstrated it in much more striking and—one might almost say—provoking form.

A sartorius muscle is dissected with the utmost care from a frog and suspended in moist oxygen, or nitrogen, or air; silver or platinum electrodes are brought in contact with it and at intervals its response is tested. At first stimulation leads to an active contraction; as time goes on, however, the muscle apparently dies; it is not fatigued, it has been quite infrequently stimulated, and in oxygen or air there should not be, and in fact there is not, any accumulation of lactic acid. In an hour or two the muscle is apparently dead, it responds not at all to the strongest stimulus, though if it be taken out and tested chemically it is found to show all the chemical characteristics of resting muscle.

The phenomenon is not due to oxygen as such, or to the absence of oxygen; it cannot be attributed to surrounding the isolated muscle by a gas, since it happens also in liquid paraffin and mercury. I called it 'reversible'. Immerse the muscle, when it has become completely non-excitable, in salt solution, and its excitability returns, rapidly at first, more gradually later, following approximately a course we should expect were the return of excitability due to the outward diffusion of something present in the muscle. Any reasonable salt solution will cause a return of the excitability: Ringer's solution, sodium chloride,—anything, in fact, which does not itself lead directly to inexcitability in the muscle.

It would be easy, so far, to imagine that some product of activity in muscle, gradually accumulating, produces a toxic effect which leads to the inexcitable state. This simple suggestion, however, is not sufficient. If we soak a muscle, for three hours after removal from the animal, in salt solution, and then suspend it in a gas, it will remain excitable indefinitely. If we wash it for three hours after it has become inexcitable, its returned excitability will remain indefinitely, that is, until its carbohydrate reserves are used up or bacterial invasion sets in. If, however, we wash it for a shorter time, say for half an hour, after it has become inexcitable, its excitability indeed returns, but when we place it again in a gas, it becomes inexcitable once more. Not until the sum of the times of immersion has attained a certain value does the muscle become permanently excitable in the present sense. If any product of metabolism has a toxic effect, why should further metabolism after a 3 hour preliminary soaking in Ringer's solution now have no result? Are we dealing here with the same curious phenomenon as Furusawa found in the case of a crab's nerve? Moreover, why do the muscles of a frog's leg, allowed to remain *in situ* after the death of the animal and the removal of the skin, retain their excitability for hours, while a companion muscle dissected out and, to all intents and purposes, uninjured, becomes inexcitable in an hour? The muscle is not dead, for it shows a normal resting metabolism and can be revived by washing with salt solution; it may then live for days, which is a sign that any injury due to dissection is of negligible importance. Is the effect of a subtle physical nature, due to contact of the living tissue with a medium of unusual dielectric constant? Or is it to be attributed to the production of some substance, in or between the cells, which can be washed away by contact of the muscle with salt water? The phenomenon is an easy and dramatic one to witness, once one realises its existence, but a difficult one to explain. The realisation, however, that it occurs has greatly simplified experiments with isolated muscles, for we know now that by a preliminary period of washing we can prevent an occurrence which has spoilt so many experiments.

There is one possible explanation. If a Ringer's solution be prepared containing four times the usual concentration of potassium chloride, a muscle immersed in it slowly becomes inexcitable. One which has become spontaneously inexcitable by standing in oxygen shows no return of excitability when immersed in this solution. We might have expected a temporary return. A muscle consists of fibres and interspaces, mainly fibres. In the inside of the fibres there is a very high concentration of potassium, in the interspaces a low one. Excitability may depend—among other things—upon a normal concentration ratio of potassium across the boundary of the cell. Experiments have shown that when muscles are perfused, potassium tends to leak into the perfusing fluid. If it leaked into the interspaces between the fibres—not much would be required—it might gradually produce the same state of inexcitability as we can cause by the artificial application of a high potassium concentration. The chief difficulty in this explanation, which has much else to commend it, is that one cannot see why a few hours' immersion in salt solution should prevent any further egress of potassium. In any case it seems that the phenomenon is of a physical or of a physico-chemical nature, and has no connexion with the oxidative mechanism of the cell.

Anaerobic Disintegration in Muscle

I come lastly to the most difficult problem of all: the cause of a phenomenon which I discovered in 1927 and about which I speculated last spring, perhaps rather rashly, in the *Proceedings of the Royal Society*. I say rashly, partly because my paper was the innocent cause of much excitement in the autumn, when the public Press discussed—in the 'silly season'—the 'mystery of life'; partly because the explanation I originally gave may not be sufficient. The facts, however, seem certain, and are these: By improvements in technique, the rate of resting heat production of a muscle can be measured, in oxygen or in nitrogen. The muscle lies in nitrogen upon the warm junctions of a thermopile, in a thermostat maintained at a constant temperature. The rate of the resting heat production at 18° C. is (say) 60 gm. cm. per gram per minute: about 1½ thousandths of a calorie. The muscle has previously been washed for some time in salt solution, so that it does not now become spontaneously inexcitable in the manner described by Dulière and Horton. It is stimulated and gives a series of twitches: the heat due to activity is registered by the galvanometer attached to the thermopile: stimulation ends: the galvanometer returns: we should expect it to return, gradually, of course, to its original position, the muscle to revert to its original heat rate. Nothing of the kind. I may illustrate what happens by a typical experiment.

Time A.M. or P.M.	11 56	11 59	12 1	12 2	12 3½	12 5	12 6
Galvanometer deflection mm.	22	23½	23½	22½	22½	24	23

The muscle was then stimulated by single shocks to fatigue: the galvanometer deflected, and, when the stimulation ended, returned to rest once more.

Time P.M.	12 20	12 23	12 25
Galvanometer deflection mm.	130	130	130

The resting heat-rate in this case has been increased between five and six times.

The phenomenon has never failed to appear, and it occurs always in the same quantitative form. The quotient

$$\frac{\text{increment in heat rate per minute}}{\text{total heat by stimulation}}$$

is always (in the frog's sartorius at 17° C.) of the order of 0·0075. The high heat rate induced by stimulation is permanent so long as the muscle remains in nitrogen. It may attain 800 gm. cm. per gram per minute after severe fatigue—more than 1 calorie per gram per hour. It may remain at this level, so long as the muscle is kept in nitrogen, for 24 or even 48 hours, in which time the total heat liberated may be many times as great as can possibly be accounted for by the breakdown of *all* the available carbohydrate into lactic acid. Since, apart from carbohydrate, there is very little except the actual protein of the muscle which we can imagine to break down with such an evolution of heat, we are forced to conclude that the process of anaerobic activity (or its products) has somehow induced the degradation of the muscle protoplasm itself to bodies containing less total energy.

If, when the muscle has been fatigued in nitrogen, and its resting heat rate is high, we admit oxygen, a recovery process sets in as usual, with a considerable evolution of heat. The lactic acid is removed and the muscle is restored to its previous resting condition. This occupies about an hour. If, now, we replace the oxygen by a stream of pure nitrogen, within half an hour diffusion on one hand, and the resting metabolism of the muscle on the other, have removed the last traces of oxygen from the interior of the muscle substance, and the resting heat rate in nitrogen can again be measured. Instead of the high value found after stimulation, we now observe a low value of the same order of size as before it. The breakdown processes produced by anaerobic activity have been cut short and the muscle has regained its previous steady state. The same treatment can then be applied once more. If the muscle be stimulated to fatigue again its resting heat rate rises: if oxygen be again admitted recovery ensues, and finally a low value of the resting heat rate appears as before.

There seem to be two alternatives: either (1) the provision of energy by oxidation has restored to their normal state the membranes, interfaces, or agents, which in ordinary life hold apart the unstable reacting substances present in the living cell, which prevent—as I said in my paper—the organised system of the living cell from becoming a biochemical chaos; or (2) in the presence of oxygen some substances have been removed, perhaps by simple oxidation, perhaps by restoration to a precursor, which, if they be allowed to remain, assist as catalysts, or in some other capacity, in the anaerobic disintegration of the living material. One thing seems certain—the high heat rate *is* a sign of some kind of irreversible breakdown or disintegration: if—as Kupalov has shown—it be allowed to continue for a few hours, no subsequent restoration of the muscle to its normal excitability is possible, either in oxygen or in oxygenated salt solution.

The phenomena in question are so curious, and the effects so relatively large and so easily demon-

strated, that they demand an explanation They have been tested by every means available and have withstood the attack Were they due to a change in the hydrogen ion concentration caused by the liberation of lactic acid ? A resting muscle was immersed in pure carbon dioxide and its heat rate remained practically unaltered the carbon dioxide must have made it as acid as extreme fatigue Were they due to a technical error of some kind ? To a reaction of some fatigue product with the metals of the thermopile ? The thermopile was insulated with baked 'Elo' (an artificial resin), shellac, and paraffin wax on top of these a piece of tin foil and over this a further layer of wax The phenomenon appeared quantitatively as before It is inconceivable that breakdown products of muscular activity can penetrate wax, tin foil, wax, shellac, and 'Elo', one on top of the other Was it due to injury in dissection ? It was found unaltered in a frog's gastrocnemius, which can be prepared with a minimum of injury The temperature was lowered to 0° C The high heat rate existing in a fatigued muscle diminished to one sixth, which is what we should expect were it due to a chemical process occurring continuously, not at all what we should look for were a technical physical error the basis of the phenomenon

I was inclined, when I first described the phenomenon, to the first of the two alternatives just mentioned, to the belief that oxygen restores the normal interfaces, or conditions, which prevent the organised system from becoming a biochemical chaos During the last few months, however, I have come across another effect which inclines me a little to the second alternative—perhaps both are correct The experiment is a simple one and the result quite certain it ought to have been made long ago but one only thinks of these things slowly If a muscle showing a very high resting heat rate induced by anaerobic stimulation be immersed for an hour or two in *oxygen free* salt solution, its heat rate returns to its original low level the muscle need not even be alive it may have been 'electrocuted' by excessive stimulation, it may have been irreversibly damaged by too long a maintenance of its high heat rate in nitrogen Yet, under the influence of the washing, in a time which suggests diffusion outwards of some catalysing agent, the breakdown evidenced by the previous high heat rate is completely—or almost completely—stopped Clearly, oxygen as such is not necessary for a reversal of the effect Perhaps if lactic acid be not already present in excessive amount, the lactic acid breakdown can take the place of oxidation in the maintenance of the normal internal architecture of the cell perhaps, however, *something* is set free in the absence of oxygen, which induces—or helps to induce—the irreversible breakdown of the muscle protoplasm with a liberation of energy a something which can be dialysed away by immersion of the muscle in salt water

It is well known that, in man, too prolonged exposure to anoxæmia may produce harmful effects lasting for a long time or even permanently As Haldane writes "A short exposure even with loss of consciousness produces no serious after symptoms but occasionally a man's behaviour is very abnormal for a few minutes after recovery" "With severe and prolonged exposure to want of oxygen the nervous after symptoms are of an extremely formidable nature and often end in death" "The symptoms are evidently due in the main to widespread injury to the nerve cells during the exposure" "The heart may also suffer in prolonged exposure to want of oxygen The after symptoms may be mainly cardiac, it may be a considerable time before the heart fully recovers" "Probably every other organ and tissue in the body feels the after effects of severe exposure to want of oxygen The patient often enough dies of pneumonia Acute nephritis and gangrene of extremities have been noted" And so on May we not be witnessing here in man the after effects of the same partial disintegration of the living protoplasm as can so easily be demonstrated in anoxæmia in the isolated muscle ?

In Warburg's work we find further evidence of a harmful effect of oxygen lack An embryo of a chick is kept for some hours in salt solution saturated with nitrogen oxygen is then introduced In the normal embryo there is practically no lactic acid formation if sufficient oxygen be present the free energy required for continued existence is supplied by oxidation In the embryo which has been subjected to a period of anoxæmia, however, the capacity for oxidation is found to be diminished and a large part of the energy it requires must now be derived from the lactic acid breakdown By anoxæmia, in fact, the normal embryo has been reduced to a state in which its metabolism is similar to that which Warburg has found to characterise tumour tissue Can it be, as Warburg's work suggests, that oxygen lack, working upon the normal architecture and machinery of the cell, leaves behind a type of mechanism analogous to that of tumour ? Dare we see in the disintegrative process set up by anaerobic activity in the isolated muscle cell an exaggerated case of the harmful effect produced in man by prolonged and severe anoxæmia, or in the chicken embryo by oxygen want ? It is dangerous to speculate too far, but it is foolish not to speculate at all

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learn to look at architecture as it might appear to an observer from another planet, to whom its human origin was unknown, and on the whole this detachment is more nearly attained by the landscape painter than by the historian or even, perhaps, the architect himself

The old towns of the Riviera crowning the foot hills of the Alpes Maritimes, or capping promontories which project against the blue Mediterranean, provide as usual the subject for one kind of culmination of natural in architectural form Of the purely natural landscape of this delightful coast there are as usual several studies, of which Mr H Van der Weyden's The Lone Pine of La Mortola (208) is the most considerable, but it is to be regretted that the landscape of the tropics should be almost unrepresented in the Exhibition The gamut of the emotions evoked by the world's scenery remains incomplete so long as the tropics are passed over, and the traveller longs to see at least something which will recall the coast with fringe of waving palms and the gleam of green translucent water within the coral reef, with its line of foaming breakers and deep blue sea beyond

Among the artists who are enterprising in their research for natural effects Mr W L Wyllie is certainly to be reckoned, and in Fifty North and Forty West (207) he gives us the impression of an occurrence which is never seen without a thrill of excitement, the sudden breaking away of the whole summit of a great dome shaped wave in the foaming cap which sailors call a 'cauliflower sea', which, launched bodily forward, is here seen rolling towards the observer

Such were the aspects of Nature, or the emotions aroused by aspects of Nature, which I found observed and recorded by our fellow students, the landscape painters in this year's Exhibition of the Royal Academy

News and Views

IN his Ludwig Mond lecture, delivered recently at the University of Manchester, the main part of which appears as a supplement to this issue of NATURE, Prof A V Hill refers to the value of experiments carried out on isolated animal tissues for the elucidation of the phenomena of life, and illustrates his thesis with descriptions of some recent work performed on the isolated nerve and muscle of cold blooded animals Both tissues consume oxygen not only as a result of activity but also whilst at rest it appears that not only is the production of energy in the form of a nerve impulse or a muscular contraction accompanied, or followed by, the consumption of oxygen, but also oxygen is required for the process of remaining alive and irritable, of being ready to respond to a stimulus The isolated muscle uses the absorbed oxygen to oxidise glycogen, in the absence of oxygen, lactic acid is formed from the glycogen, which breaks down much more rapidly than in the presence of oxygen, and the free energy of this breakdown suffices to maintain irritability in the muscle for a short time, provided that the lactic acid is removed by immersing the muscle in saline In the presence of oxygen a portion of the acid is completely oxidised, but the remainder is resynthesised to glycogen, so that in the presence of oxygen the muscle lives much longer than in its absence

THE next step in the chain of evidence given by Prof Hill is the result of studies of a muscle stimulated in nitrogen to fatigue The heat production at rest after the stimulation is much greater than before, and may in time exceed the amount that can be obtained by the breakdown of all the carbohydrate into lactic acid, indicating that the muscle protein is also breaking down The resting heat production can be reduced to its low pre stimulation level by immersing the muscle in oxygen free saline or by supplying it with oxygen The exposure to nitrogen, then, appears to have initiated a degradation of the muscle protoplasm which can be stopped by again admitting oxygen, or by washing away some substance which may be supposed to aid the protoplasmic breakdown In any event, the deleterious effects of asphyxiation appear to be due to disintegration of the cells of the tissue themselves, and, conversely, oxygen is necessary for the maintenance of cell structure Put in other words, Prof Hill argues that the living cell may be considered to be in a state of dynamic, as opposed to static, equilibrium, and therefore to require a supply of oxygen for the maintenance of its very structure

ON Monday next, May 13, Messrs Sotheby and Co will offer for sale a collection of letters (1743–1820) from and to Sir Joseph Banks, president of the Royal Society They are being sold by a collateral descendant of Dorothea Lady Banks, wife of Sir Joseph Banks The series includes botanical and horticultural letters and papers of Australian interest—communications to Banks from the early governors of New South Wales—also letters of Matthew Flinders, George Bass, and Bligh It would seem improbable that any have been published, no indication, however, is supplied as to this The correspondence is suitably secured in handsomely bound folio albums, each having a list of contents, though unfortunately no numbers are given to accord with the sequence of letters, thus reference is tedious

AMONG miscellaneous matter (Lot 7) we notice a letter of Thomas Young, in a fine script, addressed to Count Rumford at the Royal Institution and dated July 9, 1801 It refers to his appointment to the professorship of natural philosophy 'As to the journals", he says, "I should not much object to engage that a sheet or more should be read for publication every week, but I conceive that it would give them additional importance if it were left to the discretion of the professor, with the approbation of the committee, and with proper notice, to publish a number at the end of a fortnight instead of a week, whenever there might appear to be a real deficiency of

matter to fill it As I think I should want little or no assistance either in translating or transcribing, except what Mr Davy might have the goodness to give me, I hope when you have reconsidered what I have stated you will not much differ from me in opinion "

AT Oxford, on May 4, under the auspices of the Society of Friends of the Old Ashmolean, a public lecture was delivered by Prof D'Arcy Thompson on "The Hellenic Element in the Development of Science" It was shown that Aristotle's doctrine of excess and defect, applied by him in the region of biology as in that of ethics, was in accordance with conceptions of Greek mathematicians in regard to the theory of numbers, especially as developed in later times by Theon of Smyrna in the series known as the 'indeterminate' or 'boundless' dyad The geometrical aspect of number was always kept in view by the Greeks, Euclid's treatment of the square of the hypotenuse exemplified this, and his whole system culminated in the dodecahedron with its pentagonal surfaces Much of the fabric of modern science has its foundation in the mathematical conceptions amplified and illuminated by the genius of the Greeks, but shared with them by other peoples, as by those of Egypt and Chaldea The lecture, which was largely attended, was followed by a meeting at which various donations to the Lewis Evans collection were announced, and means were considered for increasing the membership of the above mentioned Society

ON Saturday, May 11, Lord Birkenhead is to unveil stained glass armorial windows given for the embellishment of the staircase of the Old Ashmolean Building, Oxford Two armorial windows are being added to those already in the Museum to commemorate the foundation gift of historic scientific instruments by Dr Lewis Evans, and in gratitude to four of the great City Companies which by timely benefactions made it possible for the University to install the Evans collection in the Old Ashmolean, and thus to fulfil the condition on which it was offered to Oxford The Evans window is presented by certain members of the Society of Friends of the Old Ashmolean, chief among whom was the late Lady Osler It is inscribed LUDOVICUS EVANS, D SC, QUI MUSEUM ASHMOLEANUM DENUO LOCUPLETAVIT INSTRUMENTIS NATURALIS SCIENTIAE COLLATIS HIC COMMEMORATUR MCMXXV The second window, given by Sir Dugald Clerk, bears the arms of the Companies of the Goldsmiths, Ironmongers, Clothworkers, and Fishmongers It is a delightful composition, and a reminder of their many services on behalf of education The inscription runs MUSEI ARMARIA INSTRUXIT ET ARCAM DITAVIT GILDARUM LONDINIENSIUM LIBERALITAS QUARUM INSIGNIA DEPINGENDA CURAVIT DUGALDUS CLERK MCMXXIX The earlier windows commemorate Elias Ashmole, the first founder of the Museum in the seventeenth century, and his friends, John Tradescant the younger, Dr Plot, and Sir Christopher Wren The new windows which Lord Birkenhead is to unveil relate to the re founding of the old Museum in the twentieth century after a lapse of thirty five years, during which it had been allowed to fall into a neglected state

AMONG the portraits in the exhibition now open at the Royal Academy, that of Sir Ray Lankester by Sir William Orpen is acknowledged to be the outstanding picture of the year The fundamental note of the picture is that of declining years, yet the harmonies give it wonderful tone There is still an inquiring look in the face, with its fine forehead and the clear, steady eyes which always seem to mirror thought and observation, while the beautifully formed hands are given their full value in an easy attitude which seems to signify rest after labour Another very successful portrait is that of Prof J Millar Thomson, emeritus professor of chemistry, King's College, London, by Mr P A Hay Mr Richard Jack exhibits a fine picture of Lord Moynihan, president of the Royal College of Surgeons, and other portraits of people well known in scientific circles are those of Mr E F C Trench, past president of the Institution of Civil Engineers, by Mr George Harcourt, Mr W Tapper, president of the Royal Institute of British Architects, by Sir William Orpen, Mr J L S Hatton, principal of the East London College, by Mr Augustus E John, Prof Priestley Smith, emeritus professor of ophthalmology, University of Birmingham by Mr Harold Speed, Sir Hugo Hirst, chairman and managing director of the General Electric Co, Ltd, by Mr Richard Jack, and Mr A S Ramsey, president of Magdalene College, Cambridge, by Mr Francis Dodd There is also a bust in bronze of Col R E Crompton, by Mr George H Paulin, and a miniature of Prof J P Hill, by Elizabeth A Steele

THE fourth Huxley Memorial Lecture of the Royal College of Science was delivered by Prof F O Bower, at the Imperial College of Science and Technology, on Friday, May 3 the title being "The Origin of a Land Flora, 1908–1929" Prof Bower began by referring to his book "The Origin of a Land Flora", published in 1908 He summarised the theory of 'interpolation' there put forward to account for the origin and progression of the spore bearing plants, the dominance of which is so striking in all land plants from the ferns upwards He then indicated the more important modifications in the view expressed twenty one years ago which have resulted from advances in botanical knowledge The chief of these concern, first, the expansion of our knowledge of alternation of generations in the brown and green algæ and the significance of the cytological distinctions between the two generations in these plants Secondly, the outlook has been changed by the increase in the knowledge of the very simply organised plants now known to have existed in early Devonian times, thirdly, a study of the embryology of the Psilotaceæ has shown that this group now stands nearest to these ancient fossils

GIVING these new facts and others their full value, Prof Bower holds that his position as stated in 1908 needs "neither reversal nor obliteration but only modification" He suggested that the remote ancestors of the Archegoniatæ were of the same general type as the Green Algæ, but in these ancestors the act of meiosis was deferred, and a diploid phase

interpolated which was structurally suited to sub aerial conditions and bore numerous spores These plants would thus at one stroke achieve three bio logical advantages of prime importance (1) a multi plication of possible combinations of hereditary characters (as suggested by Svedelius), (2) an opportunity of securing a wide spread on dry land by the dissemination of spores, and (3) relief from dependence on repeated syngamy by numerical increase on land, where the necessary medium of external liquid water is not always available In conclusion, Prof Bower pointed out that while the gap between the Algæ and the Archegoniatæ is still open, and indeed remains as in 1908, yet the evolution of the constituent parts of the land living sporophyte can now be traced with the aid of the early Devonian plants

According to a recent *Daily Science News Bulletin* issued by Science Service, Washington, D C, a notable invention was announced to the National Academy of Sciences on April 19 by General G O Squier, the inventor of 'wired wireless' The principle of wired wireless is the same as that used in sending telegraph or telephone messages over lines carrying signals of different frequency or over power lines The new method, which is called the 'monophone', is the per fection of a form of radio transmitted partly by telephone wires In America the ether is incon veniently crowded with messages of all kinds It is now proposed to make the ordinary telephone wires carry some of these so as to relieve the congestion In particular, without interfering with the present point to point service of the broadcasting and without change of equipment, the telephone wires can be made to work sixteen hours a day, bringing the broad casting programmes to the householder It is sug gested that this 'line radio' could be made to provide a method of financial support to the broadcasting companies, thus eliminating the necessity of broad casting advertisements both directly and indirectly The small power used in this system is also claimed as a further advantage The power taken by a small incandescent lamp would be sufficient to supply five thousand telephones When operating the telephone connected set, no tuning would be necessary To get a new programme all that is necessary is to turn a switch Fading and the various kinds of interference which prevent good broadcast reception would be eliminated There would be no difficulty in receiving sound motion pictures and television by this method It could be usefully employed for educational purposes

Another development in broadcasting was de scribed by Prof A L Foley, of Indiana University, in a paper read on April 23 to the National Academy of Sciences, on a new type of microphone for use by broadcasters and public speakers It is still in the experimental stage, but as the principle is novel it is considered to be very promising It contains no moving diaphragm A usual type of microphone (or 'mike' as it is frequently called in America) is the condenser microphone A thin diaphragm of metal is hung in front of a metal plate with an air space between them Both have electrical charges, and as the diaphragm is pushed or pulled by the sound waves the electrical charges fluctuate in value and electrical currents flow Some of the energy is radiated into space and picked up by the receiver's set The difficulty with any type of diaphragm is that it has free vibration periods of its own which it tends to assume, thus distorting the forced vibrations due to the sound waves In Prof Foley's micro phone there are only two solid metal plates with an air space between them The sound waves of the speaker's voice directed between the plates cause alternate condensations and rarefactions of the air As the air is acting as the dielectric of the condenser formed by the plates, the rapid changes in its density cause alternating currents in the plates, which are used to radiate energy into the ether Prof Foley says that the new device is in process of development and will not be on the market for some time

There is always interesting matter in the Annual Report of the Zoological Society of London, the centenary celebrations of which were referred to in our issue of May 4 The outstanding feature of this year's report is the remarkable record diagrammati-cally presented in its "Century Chart of Progress" On the whole, the chart shows a steady record of pro-gress, apart from a slack period which began in 1839 and continued for about thirty years But the extra-ordinary rise in the numbers of members and of visitors to the Zoological Gardens in Regent's Park, and in income, which commenced in 1910 and has carried the Society from height to height in almost unbroken leaps, is witness to the success of the policy of Dr Chalmers Mitchell and the Council, and perhaps also to an increasing love of entertainment which has seized the people of Great Britain There has been a certain increase in the numbers of deaths, especially amongst mammals and birds, but this is attributed to the increased size of the collection, and the installa-tion of electric heating and lighting into more of the houses in the Gardens shows that every effort is being made to ameliorate the living conditions No indication is given of the effect upon general health and mortality of the electric systems already installed Such information, based upon the definite records of the pathologist, would afford an invaluable guide to other zoological gardens at home and abroad which, on account of the great cost, hesitate to install electric fittings until their value has been clearly proved

The second number of the *Realist* continues some of the subjects begun in the first and gives a clearer idea of the general idea which the promoters have in mind It is to be a journal of scientific humanism, and this must mean treating of matters of living human interest in the light of scientific research It does not at present offer any review of scientific works or attempt to summarise the recent additions to our knowledge, but matters of current moment and discussion are taken up and suggestions made as to the lines of future development The emphasis, in fact, is rather strongly laid in these opening numbers on the present and still more, the future The first article in the May issue, by G E G Catlin, deals in this spirit with the 'Next Step for Democracy'

The outstanding point in the recent American presidential election is well taken Both candidates were in the true sense realists and represented a great advance in the political sense of the democracy which adopted them as its champions It is clear that in the modern conditions of extreme complexity and world wide extent of industrial and social relations, real expertness is needed in those actually in power It is also apparent that control of the industrial conditions and relations of one State and another has already become more important than the merely political relations of the old governments and diplomacy This involves more scientific expertness on the part of the governors and a better appreciation of such expertness on the part of the governed

MOST of the other articles in the *Realist* for May strike a similar keynote to that sounded by Prof Catlin That on the "Crisis in Psychical Research", by Mr E J Dingwall, will interest a good many people by its suggestion for a new thoroughly sound and independent investigation of recent phenomena of a spiritualistic kind The point is made that the Society for Psychical Research, which was founded to do this very thing, has lost its standing as a scientific body just at the time when the phenomena to be investigated have become more numerous Dr Charles S Myers gives an account of the work and the results of the Institute of Industrial Psychology Cases are quoted in which not only greater industrial efficiency has been secured and sickness among employés has been reduced, but also the earnings of the workers have been increased Mr H Martin Leake has a somewhat similar plea for the rationalisation of British agriculture Dr Norman Haire concludes his account of the recent experiments in rejuvenation, mainly of Voronoff and Steinach He sounds a fairly hopeful note while admitting that it is at present impossible to decide whether any of these procedures actually prolong life in a human being Dr A P Laurie has a short but very interesting and convincing defence of the scientific analysis of the materials and methods of the old masters Much of this has appeared in letters to the *Times* and it is useful to have it collected The editor, Major A G Church, has an equally persuasive article on the need of applying scientific methods to the development of our imperial possessions This is imposed upon us, both by our monopoly of so much of the world's richest soil and the 'sacred trust' which we have professed to the world for the well being and development of the backward races

THE curators of the University of Edinburgh unanimously agreed to offer the principalship—which will become vacant on Sept 30 by the resignation of Sir Alfred Ewing—to Sir Thomas Holland, Rector of the Imperial College of Science, London, who has accepted the appointment Sir Thomas is at present in South America, and the negotiations have been completed by cable He is to be president of the British Association during the forthcoming meeting in South Africa, and it is understood he will not arrive in Edinburgh until about the middle of October He will take to his new office a wide experience—academic and administrative—and extensive first hand knowledge of conditions in the Dominions and in India, a matter of great importance to the University of Edinburgh, which has more students from over seas than any other university in Great Britain

AT the meeting on May 2 of the Linnean Society of London the following honorary members were elected Dr Theodor Mortensen, superintendent, Zoological Museum, University of Copenhagen, distinguished for his researches on Echinodermata and other marine organisms, Prof Carl Hansen Ostenfeld, professor of botany and director of gardens and museum, Copenhagen, distinguished for his researches on the taxonomy and distribution of arctic plants, and also on cytology, heredity, and phytoplankton, Prof Bohumil Němec, professor of plant anatomy and physiology, Charles University, Prague, distinguished for his researches in cytology, physiology and anatomy of higher plants, and in mycology and bacteriology The presidential address of the Society will be delivered at the anniversary meeting on May 24, when the Gold Medal will be presented to Prof Hugo de Vries, who, unfortunately, on account of ill health, will not be able to be present

THE fortieth anniversary of the completion of the Eiffel Tower in Paris was celebrated on May 2 by the unveiling of a bust of Gustave Eiffel at the base of the tower The ceremony was performed by M G Martin, Secretary for Posts and Telegraphs, who paid a tribute to the great engineer Eiffel was born at Dijon on Dec 15, 1832, and died in Paris on Dec 28, 1923 He was a student of the École Centrale des Arts et Métiers, he obtained a wide experience of engineering construction, and by 1887, when he began the Tower, had built iron and steel bridges, etc, of more than 100,000 tons total weight The Tower, which is 984 feet high, is still the highest structure in the world It is a resort of sightseers, but it is also used as a wireless and meteorological station Nearly 14,000,000 persons have ascended the Tower since its construction Eiffel served as president of the French Society of Civil Engineers and was also an honorary life member of the British Institution of Mechanical Engineers

THE Ministry of Health has issued a statement respecting the present situation in regard to smallpox Smallpox of a mild type has been prevalent in England and Wales during the last few years, and in 1928 there were 12,420 cases with 53 deaths The distribution of the disease has been relatively wide, but it has been kept under control or stamped out in all of the 35 or 40 counties in which it has appeared, except in some five to ten districts where it has obtained a greater hold, owing in particular to neglect of vaccination In the Administrative County of London, with a population of 4½ millions, only 167 cases have occurred this year Some uneasiness has been occasioned by cases derived from the s s *Tuscania* This vessel arrived from Bombay at Marseilles on Mar 27 with passengers and crew numbering 1589, afterwards proceeding to Liverpool and Glasgow In all, 45 persons from the *Tuscania* have been notified as suffering from smallpox, of whom 7 have died,

but there is reason to think that this epidemic is now at an end, and as a result of the rigorous measures taken, English ports have been kept free

THE Yorkshire Naturalists' Union, founded in the sixties of last century, is one of the oldest, as it is one of the most flourishing of the amalgamations of natural history societies in Great Britain The Annual Report for 1928 states that the affiliation includes thirty eight local societies, and the summaries of work accomplished by the various sections of the Union show how active is the interest taken in the fauna, flora, and geology of the county The official organ of the Union is *The Naturalist*, a magazine the usefulness of which as a medium for the publication of natural history in all its branches is emphasised by the absence of an all England magazine of the same kind It is a remarkable fact that, since *The Zoologist* died, a Nature loving country like England should possess no periodical dealing with general natural history on the lines followed by that much lamented journal

THE Government Museum at Madras, under the superintendence of Dr F H Gravely, and, during his absence in Europe in 1927, of Prof E Barnes, continues to make good progress Like other progressive museums, it finds that detailed specialist collections are unsuitable for exhibition, and accordingly the Bruce Foote collection of prehistoric implements has been stored for reference, and the valuable exhibition space which it occupied has been given over to a much needed expansion of the ethnological collection The Buddhist sculptures have been rearranged, and a description of part of this exhibit is in the press, and various improvements have been made in the zoological and the coin collections Appendices to the Administration Report for 1927–28 show that the Museum receives a very small proportion of its material as gifts from the public, and that a surprising number of coins and of copper statues of saints and kings turned up as treasure trove in the villages of the Presidency

A SOMEWHAT alarmist article on "Fundamentalism in England", by Maynard Shipley, appears in the March number of *Evolution* Among other statements, it alleges that "much anti scientific propaganda is being 'put over' in the smaller provincial towns and vast districts of Wales, Ireland, and Scotland, where people still believe in witchcraft, as firmly as our 'Pennsylvania Dutch' towns where no hint of modern scientific thought has so far penetrated" So far as our experience goes, Mr Shipley's statement, as it refers to Scotland, at any rate, is as shaky as his composition We have never denied that there is a strong undercurrent of dislike to the theory of human evolution in the British Isles, but it is the 'die hard' resistance of conservatives who do no more than wish their old fashioned beliefs to be left alone. It certainly does not express itself in active and fussy propaganda, and much of it will die with its generation As for witchcraft in Scotland, the most we can say is that a canny Scot may occasionally believe in luck, but even evolutionists of the highest standing have been known to risk their chances at the casinos of Europe

SOME four or five years ago Dr Percy R Lowe, of the British Museum (Natural History), discussed with the eminent French ornithologist, M Jean Delacour, plans for a joint Franco British Expedition to Madagascar to collect specimens of both living and extinct animals which might possibly supply further clues to the origin of the fauna of this, one of the most interesting islands in the world What was most desired was the discovery of more remains of the extinct ostrich like fossil known as *Mullerornis*, which may throw light on the past history of all struthions, or ostrich like birds, and incidentally perhaps of the island itself Another most welcome discovery would be a complete skeleton of the giant flightless bird *Æpyornis maximus*, which stood at least ten feet high Funds for such an expedition have now been provided by Mr Arthur Vernay, and the Trustees of the British Museum have loaned the services of a palæontologist, Dr Errol I White, who is due to arrive at Madagascar towards the end of May At the last moment the Expedition has been joined by a party of American scientific workers It is now, therefore, representative of France Great Britain, and the United States of America

THE Royal Horticultural Society is issuing invitations to the International Congress which the Society is arranging to be held in London on August 7–15, 1930, that is, immediately before the International Botanical Congress meets at Cambridge A representative executive committee has been appointed by the Society, with Lieut Col Durham, the secretary of the Society, as secretary, to whom the subscription for membership, one pound, should be paid The programme will include lectures and excursions, and a flower show on the last two days The main subject for discussion will be "Propagation vegetative and seminal", for which communications are invited and in which eminent British and Overseas authorities have already signified their intention of taking part There will also be other sections, and suggestions for papers for consideration are invited The six committees appointed at the Vienna Congress in 1927 will present their reports These include a Committee on Nomenclature, the report of which will be awaited with special interest in view of the lack of uniformity in the use of plant names, especially of varieties and hybrids, which exists at present among horticulturists Communications by means of papers, or participation in the general discussion, will be permissible in English, French, and German All correspondence should be addressed to the secretary of the Royal Horticultural Society, London, S W 1

THE first conversazione this year of the Royal Society will be held at the Society's rooms at Burlington House, W 1, on Wednesday next, May 15

UNDER the Order in Council dated Feb 6, 1928, the Lord President of the Council has appointed Sir James Alfred Ewing to be a member of the Advisory Council to the Committee of the Privy Council for

Scientific and Industrial Research, to fill a vacancy occasioned by the death of Mr Robert Whyte Reid

Sir James Irvine, Principal of the University of St Andrews, has been awarded the Elliott Cresson Gold Medal of the Franklin Institute of the State of Pennsylvania "for his brilliant research on Carbo hydrate Chemistry" The Medal will be presented on May 25, and will be accepted on behalf of Sir James Irvine by Sir Esmé Howard, British Ambassador to the United States

At the annual general meeting of the Society of Glass Technology, held in Sheffield on April 17, Mr Herbert Webb, of Stourbridge, was elected president in succession to Mr Walter Butterworth, Sen The following other officers were elected —*Vice Presidents* Mr E A Coad Pryor, Dr C J Peddle *General Treasurer* Mr Joseph Connolly, *American Treasurer* Mr F C Flint, *Hon Secretary* Prof W E S Turner

The council of the Institution of Civil Engineers has recently made the following awards in respect of papers read and discussed at the ordinary meetings during the session 1928–29 A Telford Gold Medal and a Telford Premium to Mr Conrad Gribble (London), a George Stephenson Gold Medal to Mr Harry Hall (London) Telford Premiums to Messrs H N Colam (London), F W A Handman (London), T P M Somers (Glasgow), H V C Johnstone (Sudan), and jointly to J H Hyde (Twickenham) and H R Lintern (Teddington)

The disastrous earthquake which occurred in Khorasan, Persia, on May 1, was recorded as a well marked disturbance at Kew Observatory The preliminary tremors reached the Observatory at 15 h 45 m 28 s G M T, and the records indicate that the epicentre was near lat 35° N, long 54° E The disturbance lasted about three hours, and the maxi mum displacement of the earth at Kew was nearly half a millimetre It is reported that a large area has been devastated and that great loss of life has occurred

It is announced in *Science* that the committee of the Academy of Natural Sciences of Philadelphia appointed to select a recipient for the Hayden Memorial Geo logical Award for 1929 has nominated Dr Charles Schuchert, professor emeritus of palæontology in Yale University, for the award, in recognition of his distin guished work in invertebrate palæontology, palæogeo graphy, historical geology, and the migration of faunas The Hayden Award was founded in 1888 by Mrs Emma W Hayden as a memorial to her husband, Dr Ferdinand V Hayden, director of the U S Geological and Geographical Survey in the early days of that organisation It consisted at first of a bronze medal with an honorarium in cash, but it now consists simply of a gold medal, and is given for pre eminent research in geology, palæontology, or in related sciences

His Majesty the King has approved the award of the Royal Medals of the Royal Geographical Society as follows Founder's Medal to Mr Francis Rennell Rodd for his journeys in Aïr and his studies of the Tuareg people, Patron's Medal to Mr C H Karius, assistant resident magistrate, Papua, for his crossing from the Fly River to the Sepik The Council has made the following awards Murchison Grant to Mr C S Elton for his three seasons' study of the distribution of life in Spitsbergen, Back Grant to Mr C P Visser for his exploration of the Hunza Karakoram glaciers, Cuthbert Peek Grant to Lieut Donald Cameron for his journey across the Sahara from Nigeria to Algiers, and Gill Memorial to Mr George Dyott for his recent expedition in search of Colonel Fawcett

With reference to the note in Nature of April 27, p 655, on the Huygens' object glasses presented to the Royal Society, it has been pointed out to us that Dr R T Gunther photographed the signatures "Constantine H", scratched on all three object glasses with their focal lengths, and published them in "Early Science in Oxford", vol 2, p 300, in 1923 The photographs show the bubbles in the glass of the lenses very clearly

The palæontological collections at Upsala have increased so enormously of recent years, thanks mainly to the receipt of the vertebrate material from China so thoroughly described by Prof C Wiman and his pupils, that it was necessary to store them in about half a dozen different buildings It is good news that the Swedish Riksdag has voted the sum of 791,000 kroner (about £44,000) for a new palæonto logical institute, in which research and teaching will be more conveniently carried on Building is to begin in the autumn

We have received the Annual Report of the Calcutta School of Tropical Medicine, Institute of Hygiene, and the Carmichael Hospital for Tropical Diseases, 1928 Administrative matters are very briefly dealt with, and the bulk of the publication consists of reports of the various departments with summaries of the research work carried out, much of which is of considerable value and importance

The Report of the Director General of Public Health, New South Wales, for the year 1927 has been recently issued In addition to statistical details, reports of scientific investigations are included As in former years, a large number of rats were examined for plague infection, but none was found In all, 220 samples of milk were examined for tubercule bacilli, and in no instance was evidence of tuberculosis found—an excellent record The year was notable for the very low incidence of typhoid fever, but diph theria has continued to be prevalent The death-rate from cancer increased, and has been increasing steadily for a number of years

Applications are invited for the following appoint ments, on or before the dates mentioned —A prin cipal of the York Technical Institute—The Secretary for Education, Education Offices, York (May 18) A junior technical officer in the Admiralty Technical Pool for duty in the experimental section of an Ad

miralty Establishment at Portsmouth—The Secretary of the Admiralty (C E Branch), Whitehall, S W 1 (May 18) A head of the mathematics department of the Dundee Technical College and School of Art—The Secretary, Technical College, Dundee (May 20) A part time demonstrator in biology at King's College of Household and Social Science—The Secretary, King's College of Household and Social Science, Campden Hill Road, W 8 (May 22) A woman lecturer in geography at the Hull Municipal Training College—The Principal, Municipal Training College, Hull (May 22) Physicists and electrical engineers on the staff of the Radio Research Board of the Australian Commonwealth Council for Scientific Research—F L McDougall, Australia House, Strand, W C 2 (May 26) A horticulturist and an agricultural lecturer and warden at the Kent County Farm Institute at Borden—The Agricultural Organiser, Springfield, Maidstone (May 27) A principal of the Technical College and Junior Technical School, Horwich—J McLean, Railway Mechanics' Institute, Horwich, Lancashire (May 28) A lecturer in physiology at the Chelsea Polytechnic—The Principal, Chelsea Polytechnic, Manresa Road, S W 3 (May 31) A Government analyst for Cyprus—The Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, Whitehall, S W 1 (May 31) A teacher in engineering at the Technical College, Wolverton—The Principal, Technical College, Wolverton, Bucks (June 1) A professor of commerce in the University of Birmingham—The Registrar, The University, Edgbaston, Birmingham (June 7) A professor of physiology in the University of Sydney—The Agent General for New South Wales, Australia House, Strand, W C 2 (June 8) A temporary junior assistant in botany in the University of Aberdeen—The Secretary, The University, Aberdeen A chief mathematical master at Whitgift Grammar School, Croydon—The Headmaster, Whitgift Grammar School, Croydon A woman lecturer in mathematics and geography at St Hild's Training College, Durham—The Principal, St Hild's Training College, Durham A tutor in psychology at Loughborough College—The Registrar, Loughborough College, Leicestershire An assistant in the public health laboratories and bacteriological department of the University of Durham College of Medicine—The Registrar, University of Durham College of Medicine, Newcastle upon Tyne

Our Astronomical Column

The Planet Mercury —This planet will be very favourably placed for observation at the middle of May as an evening star, being at its greatest elongation east of the sun on May 15, when it is placed twenty two degrees east of that luminary The planet will set on several nights more than two hours after the sun, and its position near the new moon on the night of May 10 will afford a very interesting spectacle in the west north west sky if the weather is clear On the date mentioned, Mercury will set at 9 46 P M G M T, and the moon goes down at 9 45 P M The sun sets at 7 33 P M, so that the phenomenon will be best seen at about 8 30 P M and may be watched until the two objects set Mercury will be situated to the north west of the moon about two degrees, and ought to be readily visible for about an hour to an observer who commands a good open view of the west north west sky in the region of the horizon The moon will appear as a very narrow crescent, but should be distinctly observable to the unassisted eye with Mercury in close attendance sparkling with a rosy light and looking more like a star than a planet

The Centre of the Galaxy —There are two papers on this subject in the March issue of *Proc U S Nat Acad Sci* Dr O Struve makes use of the conclusion that the strength of the calcium lines in early type stars ascribed to interstellar matter is a measure of their distance, the lines becoming stronger as this increases He has grouped the results for stars within 10° of the galaxy, taking means for every 30° of galactic longitude The results when plotted show a good approximation to a sine curve the maximum of which is in galactic longitude 337 6°, with a probable error of 18° The longitude is only 10½° greater than the value adopted by Shapley for the galactic centre Hence it strengthens the conclusion that the intensity of the spectral lines is a measure of distance, since the average distance is clearly a maximum towards the centre of the system of stars It should be noted that the galactic longitude is reckoned from the intersection (in Aquila) of the galaxy with the equator of 1900 Very few astronomers pay any attention to the resolution adopted at the meeting of the International Astronomical Union in 1925 that it should be reckoned from Alpha Cygni, with the view of getting rid of the correction for precession

Prof H Shapley's paper contains photographs and diagrams of the central region of the galaxy There are very brilliant star clouds to the south of the central line, but much dark matter along this line and to the north of it It is shown, however, that the dark clouds do not spread very far, and that there are transparent regions outside them where some spiral nebulæ have been photographed, which are evidently extra galactic The dark clouds may, however, conceal rich star clouds in the central region, also the mass of the obscuring matter itself is presumably large, so that it seems possible to imagine a sufficient amount of matter in the central region to account for the high velocities of revolution of the stars about this region which Oort, Plaskett, and others have found

The Distances of Dark Nebulæ —Series 2, No 52 of *Lund Meddelande* contains an investigation by W Gyllenberg of the distances of two regions where obscuration by dark matter is indicated by paucity of stars The method used is to make star counts in the obscured region and in a neighbouring unobscured one It is assumed that the dark nebulosity blots out entirely the light of stars behind it, assumptions are made as to the absolute magnitudes of the stars visible in the dark nebula based on general stellar statistics

Mr Gyllenberg applies his method to two regions The distance of the dark matter in the America nebula near ξ-Cygni is given as between 440 and 510 light years (Lundmark had previously found 610) The distance of the dark nebula near S Monocerotis is given as 250 light years in this case Lundmark had found a value 13 times as great Mr Gyllenberg confesses himself puzzled by this large difference He considers that if the colours or spectral types of the stars were considered, a much higher degree of accuracy could be attained

Research Items

Head Hunting.—In Vol. 58, Pt. 2 of the *Journal of the Royal Anthropological Institute*, Mr. J. H. Hutton analyses the head-hunting customs of the Nagas of Assam with the view of elucidating their significance both in that area and generally. Head-hunting has been explained as due either to a desire to obtain human hair for use as ornament or the desire for human beings to send to the next world as slaves of the dead. The latter belief, though present among the Nagas, is not found among the tribes where the practice of head-hunting was most flourishing. The religion of the Naga hill tribes centres on fertility cults, with which are connected phallic observances and the erection of menhirs. But though these observances secure fertility they are not its source. This seems to lie in the souls of the dead. A wooden figure which contained the soul of the dead used to be placed on a grave by the Angami. This was thrown away before the sowing of the millet crop. Among the Ao the smoke-dried body of a dead relative was kept in the house until the first fruits were eaten, after which it was disposed of in the usual way. Other customs of a similar character point to the association of the dead body with fertility through its preservation either until the sowing of the seed or until the first fruit ceremonies, when it was torn to pieces or otherwise treated. But among the peoples of Assam the head is more especially regarded as the seat of the soul. This is specifically stated among the Ao and may be inferred from the special sanctity of the head. A soul, for example, among the Konyaks may be transferred to a wooden figure by placing a skull upon it. If, therefore, the soul is a fertiliser and it resides especially in the head, when soul matter is required it may be obtained by cutting off a head and taking it home. Then not only enemies' heads are taken, but also the heads of comrades who fall in battle are cut off and brought back so that the enemy may not benefit by them. Women who hesitate to marry a man who has not taken a head may do so from the fear that he may be the less likely to be fertile. This form of belief seems also to underlie the head-hunting customs of Indonesia and the Pacific and may be traced westward and possibly as far as Britain and to neolithic or even palæolithic times.

Asymmetry and Cross-Breeding.—In an address to the Eugenics Society, delivered on April 24, Dr. C. J. Bond dealt with hemilateral asymmetry in animals and man and its relation to cross-breeding, and made a stimulating addition to biological thought. He concluded that hemilateral—and sometimes serial—asymmetry is closely associated with previous cross-breeding. He contrasted the ancient breeds of cattle, for example, *Bos primigenus* and *Bos longifrons* and others, the horns of which curved either upwards or downwards, with such modern cross-bred animals as the shorthorns, the horns of which frequently curve upwards on one side and downwards on the other. Similarly, heterodactyly in fowls is a frequent occurrence in the F^2 product of a cross; while in man there are cases of parents with different sized ear lobes producing children whose right ears resemble those of one parent and left ears those of the other. Other examples were derived from asymmetrical eye colour in man and animals. He argued that just as Mendelian segregation occurs in the formation of gametes, so in the cell differentiation of embryonic development, when the bilateral plan of growth is laid down, there is an analogous segregation of maternal and paternal genes. The degree of asymmetry appears to depend upon the closeness of kinship of the parents, whose physiological compatibility determines the stage at which segregation occurs. He hoped that the further study of this dissimilarity *in* the individual, like the study of dissimilarity *among* individuals, would assist genetic research.

British Heronries.—Although it is commonly believed that British heronries have declined during the past few centuries, there is no evidence of such decline in the statistics collected by E. M. Nicholson and his collaborators (*British Birds* for April). The number of heron's nests in England and Wales and part of Ireland in 1928 was between 3900 and 4000, but the English total was by far the greatest (3480 to 3566) not only in absolute numbers, but also in the average number of nests in a heronry, 14 there contrasting with about 7 in Wales and about 8 in Ireland. The highest averages occur in the south, Sussex leading with 54·55, followed by Dorset 38, and Essex 36, while at the other end of the scale lies Cumberland with an average of 6, and Northumberland with 6·7. Four English colonies had a total of a hundred or more nests. While in some places there have been marked declines, as at Aldershaw in Sussex, where there are said to have been 400 nests in 1840 and are now only about 80, taking the country as a whole the heron is holding its own or gaining slightly. The Scottish statistics have not yet been thoroughly collected and do not appear here, but will ultimately be published in the *Scottish Naturalist*.

Crustacean Feeding Mechanisms.—In continuation of their work on the feeding mechanisms of Crustacea, Prof. H. G. Cannon and Dr. S. M. Manton (*Trans. R. Soc. Edin.*, vol. 56, pt. 1, No. 9, 1929) have examined the three living genera of the Syncarida, *Anaspides*, *Paranaspides*, and *Koonunga*. They conclude that the first two genera exhibit two types of feeding, raptatory (*i.e.* grasping large food particles) and filtratory, essentially homologous with those previously described by these authors in *Hemimysis*. The third genus, *Koonunga*, and probably also *Bathynella*, have given up the filtratory method and feed only on large food masses. The Syncarida can thus be grouped in two series, *Anaspides* and *Paranaspides*; *Koonunga* and *Bathynella*, comparable with the Peracaridan series, Mysidacea; Isopoda or Amphipoda. Both series commence with forms exhibiting a filtratory mechanism, and through the development of the distal portions of the mouth parts and the suppression of the proximal filtering parts, end in a purely raptatory type. The raptatory mechanisms of *Anaspides* and *Paranaspides* have become modified for scraping up algal slime and similar bottom food by the enlargement of the basal portions of the first trunk limbs. The deviation of the feeding mechanism of *Koonunga* from the dual filtratory and raptatory type seems to have followed the same lines as the evolution of the typical amphipod or isopod type from that of the mysids. The maxilla has become an attenuated biting limb and lost all trace of endopodite and exopodite. The first trunk limbs have not formed a maxillipedal plate as in the higher Peracarida, but their heavy clawed armature and their marked flexure between the merus and carpus suggest that they are used for holding large food masses over the biting mouth parts. The most important characteristic of the *Koonunga* mechanism is the concentration of biting limbs, not around the mandibles at the mouth entrance, but around the distal endites of the maxillule.

GERMINATION OF *CYATHODIUM* SPORES —The liverwort *Cyathodium*, one of the Marchantiaceæ, for a time wrongly regarded as having a British representative (*Riccia spuria* Dicks), has recently been investigated by Mr N K Tiwary at Benares, secretary of Benares Hindoo University, who has sent to NATURE a communication on the subject Mr Tiwary has succeeded in finding an abundance of germinating spores, though it has not been possible to bring about germination artificially The spores are unusual in having from two to four germ pores, they appear to have a distinct polarity, for the germ tube and rhizoids arise from opposite ends, not from a single pore as is customary There is variation in the manner of germination, the cell contents on emerging from the germ pore form either an ovoid mass or a germ tube We have thus an addition to those species which have protonemata varying between the two main types

EARTHQUAKE IN THE ALEUTIAN DEEP —A great earthquake was registered at the Hawaiian Volcano Observatory (*Volcano Letter* for Mar 14) at 3 h 11 m 22 s P M on Mar 6 (1 h 41 m 22 s A M on Mar 7, G M T), the long waves being so prominent that the pens of the seismographs swept off the smoked paper From the duration of the preliminary tremors it was clear that the origin was about 3650 km from Kilauea This is the distance of the well known earthquake region that lies to the south of the Aleutian Islands, and later reports, received from Japanese vessels and elsewhere, show that the epicentre was on the north edge of the Aleutian Deep, a trough more than 4½ miles in depth, and about 100 miles south of Amukta Island About 7 45 P M, that is, in little more than 4½ hours later, the first sea waves reached Hawaii, the largest occurring between 8 and 9 P M The range of motion in Hilo Bay was, however, only 16 inches With the equally strong Alaskan earthquake of Feb 3, 1923, the sea waves at Hilo rose about 15 feet above the normal level

ECHO AND SCATTERING WITH SHORT WAVE RADIO TRANSMISSION —Radio engineers have been greatly puzzled by the anomalous results obtained when working with radio waves less than 100 metres in length Partial explanations of some of these results are given in a paper on short wave transmission read by T L Eckersley to the Institution of Electrical Engineers on April 10 The main interest in short wave transmission, both from the practical and theoretical points of view, lies in echo and scattering effects The author classes both these results together, as ultimately the two effects merge into one He regards the conducting 'layer' as a complex structure of scattering clouds, the scattering being more intense in the lower levels of the layer Experiments carried out near Chelmsford showed that local signals from Ongar could be balanced almost perfectly by means of a special receiver On the other hand, signals from Bodmin, Grimsby, the Dutch stations, and a Berlin station at night time (during the period of weak signals) could not be balanced by any adjustment of the circuits All these stations are within the 'skip' distance Long distance stations such as Canada, Australia, India, South Africa, Rio, Java, and many other distant beam stations give results which are intermediate between those obtained from near stations and more distant stations lying within the skip distance The author considers that the direct rays from the beam stations are so weak that their effects can be neglected The rays received at Chelmsford are those scattered back from the regions where the main transmitting beam penetrates into the scattering region of the conducting layer He now estimates the effective height of the daylight conducting layer as about 48 miles in summer and 60 miles in winter The scattering of short waves bears some resemblance to that of a searchlight playing upon the clouds If the searchlight itself is hidden from view, the point of intersection of the searchlight beam and the scattering clouds appears to be the source

A NEW THERAPEUTIC LAMP —Mr Albert Eidinow describes in the *British Medical Journal* of April 13 a new therapeutic lamp, the novelty of which lies in a closer imitation of the sun's spectrum Heliotherapy consists in the exposure of the patient's body to the sun's radiations, and to those from the sky, for carefully graded periods, which are increased up to several hours as the patient becomes accustomed to the treatment and as his body pigments he thus receives long combined doses of short infra red, intense visible light, and moderately intense 'long' ultra violet radiations between 3000 and 3200 A —the latter producing by slow degrees a deep, intense pigmentation Mercury vapour lamps and arc lamps all produce intense radiations in the ultra violet at wave lengths below 3000 A, to which patients can be exposed only for short periods without the production of intense erythemas The new lamp (Fig 1) is intended to give radiations more like those of the sun, and to this end a number of small metal filament glow lamps are used in series to supply visible light and heat in the yellow red part of the spectrum, while the necessary ultra violet component and the blue light are supplied by a long vacuum mercury vapour lamp tube, from which intense source all the short radiations are filtered out To effect this, the tube of the lamp is composed of frosted silica instead of fused quartz, and in addition, a screen of 'sanalux' glass, which cuts off most of the rays below 2900 A, can be interposed between the lamp and the patient To such a lamp patients may be exposed for several hours, either sitting up or recumbent, in the same way that they may be exposed to the sun in suitable climates, and so may obtain mild applications of long wave length ultra violet radiations together with the warming and stimulating heat and light from the glow lamps The lamp may be used for photographic purposes and for artificial daylight illumination, as for colour matching its light is almost indistinguishable from daylight

FIG 1

PHOTOGRAPHING ARTIFICIAL DISINTEGRATIONS —The practical difficulties which arise in the study of artificial disintegration by the Wilson cloud method are mostly connected with the necessity for taking a very large number of photographs Approximately

a hundred thousand normal α trails occur in nitrogen for every one in which disruption of a nucleus takes place, and it is therefore essential to work with recording devices of high efficiency In the issue of the *Proceedings of the Royal Society* for April 6, P M S Blackett has described a double camera for use with the large Wilson chamber made by the Cambridge Scientific Instrument Company, this takes two sharp photographs of the plane of the chamber on two mutually perpendicular films, a special feature in its design being that the principal plane of each camera lens passes through the line of intersection of the plane of the chamber with that of the corresponding photographic film Mr Blackett has made a detailed theoretical investigation of the optimum working conditions for this apparatus, and has shown that the magnification of the cameras should be reduced so far as possible towards the limit set by the resolving power of the photographic emulsions It is also found that if the number of tracks photographed in each beam of particles is made too large, there is a falling off in the observable number of resolved collisions Mr Blackett's paper is illustrated by two interesting plates, one of which shows the camera and Wilson chamber mounted ready for use, and the other some sheafs of α particles, many of which have secondary δ trails radiating from them

SOLID HELIUM —The issue of *Die Naturwissenschaften* for April 19 contains a short communication from the Physikalisch Chemisches Institut of the University of Berlin, by F Simon, announcing a further extension of the melting curve of helium It had previously been established that helium could be obtained in the solid state at as high a temperature as 20° abs by the application of a pressure of 1800 atmospheres, and in this new work the transition curve has been followed to 32° abs and 3500 atmospheres It is calculated from the data already obtained that it should be possible to solidify helium at the temperature of liquid air under a pressure of 15,000 atmospheres, provided no critical phenomena intervene As is pointed out, the fact that a substance can exist as a solid at a temperature that is very much higher than the highest temperature at which it can be held liquid when in the presence of vapour—5 2° absolute in the case of helium—may be of considerable significance in connexion with the state of matter in the interior of stars

RARE EARTHS FOR SPECTROSCOPY —Adam Hilger, Ltd , have now added a number of rare earths to the list of substances of exceptionally high purity which they can supply for spectroscopic and other purposes These have been specially prepared for them by Prof L Rolla and by Dr W Prandtl, and every specimen is guaranteed to contain in general not more than 0 1 per cent of total impurity The ceria and yttria which are now available have, in fact, been used in a similar state by Honigschmid and Auer von Welsbach for determinations of atomic weights, and the dysprosia is claimed to be even better than that used by these investigators Terbium, holmium, erbium, europium, florenzium, and thulium are also shortly to be placed on the market Considering the enormous labour involved in the isolation of these bodies, the prices asked for them are very moderate, ranging from only a half guinea for five grams of Rolla's lanthanum oxide to thirty pounds for a gram of Prandtl's dysprosia Messrs Hilger also possess a considerable number of scandium compounds which formed part of the collection of Sir William Crookes, which can be had either individually or in the form of mounted museum specimens

THE ASSAY OF COAL —In the examination of coal it is found useful to amplify analyses by distillation with measurement of the products so obtained Such methods give results differing from those of large scale practice, but, with experience, correlation is possible One of the many such tests proposed, the Gray King assay, devised at the Fuel Research Station, has been widely used, and in *Technical Paper* No 21 of the Fuel Research Board (London H M Stationery Office, 1s net), J G King, C Tasker, and L J Edgcombe record experiences with the test covering several years It is shown how the assay should be modified to deal with widely divergent materials

VAPOUR PRESSURES AND DENSITIES OF AMMONIUM CHLORIDE AND IODIDE —The determinations of the vapour pressures and densities of ammonium iodide and chloride made hitherto have shown considerable discrepancies Purcell and De Lange, whose results are described in the *Journal of the Chemical Society* for February, find that the vapour of ammonium iodide is completely dissociated at all temperatures up to 400° Their measurements, made between 300° and 400°, are in good agreement with those of Smith and Calvert The case of ammonium chloride has been investigated by Rodebush and Michalek, and details are given in the *Journal of the American Chemical Society* for March The vapour pressure of this salt appears to be unaffected by intensive drying, but the rates of vaporisation and condensation are considerably decreased The vapour was apparently completely dissociated even when the ammonium chloride had been dried for ten days at 60° in a vacuum

MAGNESIUM ZINC ALLOYS —The equilibrium diagram of this system has been re examined by W Hume Rothery and E O Rounsefell, and the results were presented at the March meeting of the Institute of Metals, the relations between the magnesium zinc and the magnesium cadmium diagrams were also discussed Both series contain analogous rather unstable compounds, $MgZn_2$ and $MgCd_3$, but whilst the Mg Cd system contains wide solid solution ranges in the parent metals, the Mg Zn system shows little solubility in the two metals, but forms two very unstable compounds, $MgZn_5$ and MgZn The evidence indicates that these exist in the solid state only and not as definite molecules in the liquid It would seem that some of the numerous unstable compounds met with in alloy systems may not correspond to any definite molecule in the chemist's sense of the word In these circumstances the following suggestions are put forward in connexion with primary solid solutions and compounds of fixed composition Where two metals form a stable compound there is usually considerable evolution of energy, and we may expect solid solutions to be almost entirely absent This condition is met with in most of the alloys of the electropositive metals with the border line metals, such as tin, antimony, bismuth, etc Where two metals form an unstable compound, primary solid solutions will be formed if the atomic volumes are nearly equal, as are those of magnesium and cadmium If, however, the atomic volumes differ widely, for example, zinc and magnesium, the tendency is for the main compound to be accompanied by other compounds which exist in equilibrium with the liquid over a very small range of temperature, and may exist only in the solid state representing the patterns into which the different sized atoms can be packed with or without chemical combination, that is, electron transference or sharing

The Permanently Frozen Soils of Russia

FOR more than two hundred years it has been known that in the extreme north of Siberia there are soils the lower strata of which are in a perpetually frozen condition. Since then a considerable literature on the problem has accumulated, but it is widely scattered, partly in almost inaccessible local publications, and a general critical survey of the literature, together with the results of original observations, recently published by the Far Eastern Geophysical Observatory in Vladivostok[1] is therefore of great interest.

The author defines these perpetually frozen soils as those the temperature of which is always below the freezing point, regardless of the presence or absence of water in the soil. This definition is more exact than most of the earlier ones, which have been usually based on the soil being cemented by frozen waters. It happens with some sufficiently loose and very dry soils that their particles remain free and the soil loose even after freezing; such soils nevertheless should be classified as permanently frozen.

The geographical distribution of such soils in Russia is at present fairly well known, though the information is still very fragmentary. As a matter of fact, there are 336 places where observations on permanently frozen soils have been made; of course, these observations vary widely in their scope and in their value. However, they are sufficient for a map to be prepared from them (Fig 1). The whole area of permanently frozen soils in Russia occupies about 7 000 000 sq km, that is, very nearly one third of the whole territory of Russia, and a little less than the area of Europe, and about the same as the area of the United States or of the whole continent of Australia. The southern boundary of permanently frozen soils is, as will be seen from the map, very irregular; in European Russia it begins at the White Sea shores and runs eastwards almost parallel to the Arctic Circle and a little south of it up to Turukhansk in Siberia, where it turns sharply south eastwards until it reaches latitude 50° N; its course beyond the latter is not known, being outside Russian territory in Mongolia; near Blagoveshchensk and Khabarovsk the southern boundary of the permanently frozen soils again enters Russia, running in a north easterly direction to the northern part of Kamtchatka about latitude 60° N.

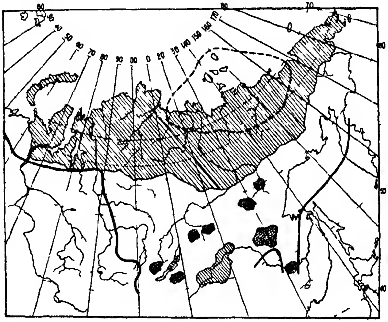

FIG 1.—Diagrammatic map of permanently frozen soils of Russia (re drawn after Soumgin). Oblique lines—continuous areas of permanently frozen soils; oblique lines and dots—areas of permanently frozen soils with islands of normal soils; crossed lines—areas of normal soils with islands of permanently frozen soils; heavy continuous black line—southern limit of permanently frozen soils; heavy interrupted black line—the boundary of the area where considerable strata of solid ice are present in the soil.

Inside this enormous region of permanently frozen soils several areas may be distinguished. Thus a very large continuous area of permanently frozen soils occupies the whole extreme north of Siberia along the shores of the Polar Sea; another compact area is situated in Transbaikalia; in the rest of the region islands of permanently frozen soils are scattered.

The depths to which soils may be in the permanently frozen condition were determined in a number of cases and fluctuate from 36 3 m in Pustozersk to 74 68 m in Taldan, Amur province, and even to 116 4 m in Yakutsk; in the latter case the actual depth has not been determined, since non frozen strata has not been reached. Detailed observations on the temperature conditions of these soils are still very inadequate. Middendorf in 1848 made some determinations of temperatures in a shaft at Yakutsk and found that the temperature decreased with the depth, reaching 3 C at 382 ft below the surface; a constant annual temperature was found at 100 ft deep. From these figures Middendorf determined the lower limit of the permanently frozen soil in Yakutsk at about 600 ft below the surface, but all his observations are somewhat doubtful as to exactitude. Much more thorough studies in this respect were made recently at Bomnak, Amur province, but they were restricted to relatively small depths not exceeding 5 m. The upper limit of permanently frozen soil at Bomnak was found to be at 2 8 m from the surface.

During the ten years of observations at Bomnak a correlation has been observed between the thickness of snow and the seasonal fluctuations of the temperature of the soil. In years when snow fell late and was not very thick, the temperature was found to increase with the depth, while in winters with abundant snow it protects the soil from cold and the temperature of the soil decreases with the depth, monthly maxima and minima of temperatures in the soil at 1 5 metres deep lagging two months behind the air temperatures. When the upper layers of the soil freeze or thaw, the water contained in them gives up, or absorbs, respectively, the heat energy, thus

[1] Everfrozen of Soil in the Boundaries of U S S R by M Soumgin Pp 372 The Far Eastern Geophysical Observatory Vladivostok 1927

interfering with the distribution of temperatures in the soil In this way a 'zero curtain' in the soil is formed which is of the greatest importance for the temperature regime of the soil, this 'zero curtain' does not lie at a constant depth, but moves up or down, according to the air temperature The amplitudes of the monthly mean temperatures at depths exceeding one metre are very small and rapidly decrease with the depth Observations in other places lead to the conclusion that three different types of the distribution of temperatures in permanently frozen soils may be distinguished, namely (1) temperature increases with the depth, (2) temperature decreases with the depth, (3) temperature decreases down to a certain depth, then increases The distribution of temperatures at greater depths has not been studied since Middendorf's work, but it may be safely assumed that it is very complicated

As regards the origin of permanently frozen soils, many authors consider them to be the result of the present climate, but Soumgin believes that they have remained frozen since the glacial period

A special chapter of the book is devoted to the study of hydrological conditions in the region of permanently frozen soils, while other chapters deal at some length with the influence of the frozen soils on the surface features, especially the distribution of forest types, and with the practical difficulties in building and other engineering work on frozen soils

An elaborate programme of studies on permanently frozen soils is put forward by the author, who concludes his interesting monograph with a somewhat startling project for establishing somewhere in the area of permanently frozen soils a refrigerator museum, where bodies of various animals and men should be deposited in order to be examined and compared with later types after several thousands of years

Fisheries of Madras

VALUABLE work by the Madras Fisheries Department is described in the administration report for the year 1926–27 by the Director, Dr B Sundara Raj (Madras Fisheries Bulletin, vol 22, pp 1 99 Madras 1 rupee 1928) The report deals mainly with the commercial development of the department as applied to fish, pearl, and chank fisheries

The Chaliyam Fish Cannery, which was expected to recommence its manufacture during this period, did not operate, as Sir F A Nicholson was prevented from undertaking the management of the experimental and manufacturing operations, due to ill health Yet it is hoped that the cannery will be continued, as it has not been given a chance to prove the commercial possibilities of canning as a remunerative industry, especially as two private canneries started on the model of the one at Chaliyam had not prospered At Tanur, researches were continued on the methods of preserving fish in a fresh condition for sale in the interior markets, of curing, pickling, and tinning bonito, cat fish, and others for disposal in Japan and other places abroad and of preparing fish oil from the liver of sardines The initial experiments carried out with sodium hypochlorite as a preservative of fish in a fresh condition have shown "that about 200 c c of solution (with 1 per cent available chlorine) is sufficient to keep 1 lb of smaller varieties of fish for over 30 hours" Fish meal, with a low fat content, was made from chamban (*Caranx crumenopthalmus*), and shrimp by the use of a press more powerful than a hand press

Investigations for improving the resources of edible fish in inland waters were continued Despite adverse seasonal conditions, the experiments at Vellore and Chingleput Fort Moat Farms demonstrated the utility of stocking catla The catla fry from the Godavari channel grew to a length of 1½ to 2 feet in eight months in these farms For want of material the Hilsa hatching experiments have not been satisfactorily concluded, the gourami (*Osphromenus sp*), the tench, and the carp have flourished in inland waters Experiments are being conducted on the trawling grounds close to the Madras coast to ascertain the possibilities of deep sea fishing

In the whole history of Ceylon and Indian pearl fisheries, no more than a single fishery was considered possible in any year For the first time, a fishery was commenced in the autumn of 1926 on Nov 6 and lasted until Dec 4 This small fishery brought a net profit of Rs 26,801 Another fishery, which excelled all previous fisheries in its excellent organisation of the camp and in the operations at sea, was opened on Feb 11 and closed on April 30 The time honoured method of fishing and disposing of the oysters was in vogue, except for the fact that the lots of 500 each were counted at sea on board the depot schooners, to avoid extra wages to the labourers and to minimise the pilfering of pearls by divers on their way back to the shore from the banks Although the usual difficulties which marred the administration of the pearl fisheries in the past, such as wrong locations of banks, epidemics, etc, were circumvented, other adverse factors, such as bad weather, depreciation of the market value of pearls, etc, contributed towards a lower yield of revenue than was anticipated Yet this fishery ranks first among those held within the last hundred years, and the Government realised a net profit of Rs 172,316 Owing to the pearl fisheries, the chank fisheries suffered a set back, and only a fourth of the normal catch in a good year was fished It is interesting to note that steps are being taken to develop the ancient chank bangle industry, and that the initial difficulty in the development of this industry has been overcome

The marine aquarium continued to be popular The researches on the development of the edible oyster (*Ostrea madrasensis*), carried out in the laboratory of the aquarium, revealed the fact that the Indian oysters fatten and breed only in low salinities, whereas the English oysters flourish when there is a rise in salinity The tiles put out at Ennur to collect oyster spat were attacked in such large numbers by a molluscan pest (*Modiola sp*) that it is proposed to abandon oyster culture in this locality It is proposed that, if the Marine Biological Station at Krusadai Island is established, its immediate lines of inquiry should be (1) Biological investigations with special reference to pearl and chank fisheries, (2) hydrographic and meteorological investigations, and (3) technical and industrial researches with special reference to fishing methods Further, it is suggested that the following laboratories, aquaria, etc, are required to start the proposed lines of research (1) The establishment of three new research laboratories, in addition to the one at Calicut, with adequate facilities, (2) the construction of aquaria at Rameswaram and at Vizagapatam, and (3) the establishment of a bio chemical laboratory equipped with requisite apparatus and staff to deal with the technology of fishery industries It is very gratifying to note that the Fisheries Department has continued with success the introduction of elementary education to children of the fishing population, the organisation of the co operative movement on a wide scale, and the promotion of temperance and other social benefits to the community

New Rubber Plant from Madagascar

DR CHARLES F SWINGLE of the U S Department of Agriculture was working in the Department of Botany of the University of Leeds during the winter of 1927 28 making a study of the vegetative propagation of plants from the anatomical point of view A problem of practical plant propagation then arose through the decision of the U S Department of Agriculture to try to introduce the rubber plant *Euphorbia intisy* from Madagascar into the United States Dr Swingle sailed from England at the end of May 1928 joining Prof Henri Humbert of the University of Algiers in a collecting expedition in the uplands of Madagascar and a statement of the results obtained has been issued by Science Service of Washington D C

Euphorbia intisy grows to be a small tree some of the largest specimens seen by Dr Swingle being about 12 ft high and 5 in in trunk diameter although trees 20 ft high with a diameter of about 1 ft are reported As a rubber plant it is remarkable for the ease with which the rubber can be collected It separates itself from the latex on exposure to air no elaborate coagulation or smoking process being necessary Years ago when the natives of Madagascar were collecting rubber for the French they would simply cut long gashes in the bark of the tree and then go round next morning and peel out strips of rubber Unfortunately this primitive collecting took place in a time of high rubber prices with the result that the tree was almost exterminated Outside Madagascar the species seems to be practically unknown and there is probably not another living plant outside the island apart from the specimens now growing in a locked greenhouse in Washington

These plants will probably provide a very considerable practical problem in vegetative propagation The species can be propagated from stem cuttings but it is of slow growth and years will be required before the stock in the United States can be increased to a point where commercial experiments can be undertaken Probably its peculiar habit of growth is responsible for the fact that the plant has survived its exploitation in its native haunts in Madagascar According to Dr Swingle the root system consists of chains of tuberous thickenings strung together after the fashion of sausages These tubers are storage organs for water enabling the plant to survive in the desert through a drought as long as six rainless years With this system of underground life assurance the remnants of the rubber forest were able to survive the massacre and to begin life over again after the activities of the rubber hunters had ceased

University and Educational Intelligence

CAMBRIDGE —The President of the Committee of the Privy Council for Scientific and Industrial Research has approved the application for a grant of £1500 to the University for the erection of the liquid hydrogen plant at the magnetic laboratory

The following grants have been made from the Worts Fund £100 to the Zoological Station at Naples £40 to H G Watkins and J M Scott towards the expenses of a surveying expedition in Labrador £50 to Miss S M Manton for researches on the fauna of the Great Barrier Reef, £15 to Dr H Hamshaw Thomas towards the expenses of a fossil collecting journey in South Africa A grant of £25 has been made from the Balfour Fund to J T Saunders for investigations on the hydrobiology of the Swiss Lakes

A Denman Baynes Scholarship at Clare College for research in mathematics physics or chemistry of the annual value of £100 will be awarded in July Preference will be given to graduates of the University of Cambridge and *ceteris paribus* to members of Clare College Applications should be sent to the tutor of Clare College on or before July 1 with such evidence of qualifications as candidates think fit to submit and a statement if possible of the proposed course of research

LEEDS The degree of D Sc has been conferred on Mr H C Versey for a thesis entitled Studies in the Tectonics of the North of England

LONDON The following courses of free public lectures are announced The Photo electric and Photo chemical Measurement of Light with Biological Applications by Dr W R G Atkins at the Imperial College of Science (Royal School of Mines) on May 14 15 and 16 at 5 30 The Physiology of Glycogen by Prof J J R MacLeod at the London Hospital Medical College on May 16 and 17 at 5 30 and Sweden and the North of Europe by Prof Sten de Geer at Birkbeck College on May 24 28 and 30 at 5 30

Applications are invited for the University Studentship in physiology value £100 Applications must reach the Academic Registrar of the University South Kensington S W 7 by May 31 at latest

The first annual memorial lecture instituted in memory of Lord Haldane late president of Birkbeck College will be given at Birkbeck College by Lord Justice Sankey on Tuesday May 14 at 5 30 P M the subject being Lord Haldane s Life and the Adult Education Movement The Earl of Lytton will preside

MANCHESTER —Applications are invited for the Sir Clement Royds memorial scholarship in chemistry of the value of £300 The scholarship is for the encouragement of advanced study and research in chemistry in the faculty of science of the University and is open to British subjects of British descent born in or inhabitants of the County of Lancaster preference being given to the county borough of Rochdale The latest date for the receipt of applications which should be sent to the Registrar is June 1

Applications are invited for the Dr Robert Angus Smith scholarship value not exceeding £150 the object of which is the encouragement of research in sanitary science Applications must reach the Registrar of the University by June 1

THE Ramsay Memorial Fellowship Trustees will consider at the end of June applications for a British Fellowship for chemical research The value of the Fellowship will be £250 per annum to which may be added a grant for expenses not exceeding £50 per annum Particulars as to the conditions of the award are obtainable from the Secretary of the Ramsay Memorial Fellowships Trust University College London (Gower Street W C 1)

VACATION Courses at Leyden Holland in August in glass blowing and instrument making have been arranged for by the Society for the Advancement of the Training of Instrument Makers Particulars of the courses may be obtained from Dr C A Crommelin Physical (Cryogenic) Laboratory the University Leyden to whom applications should be sent before June 8

ON Jan 1 the Rockefeller Foundation took over the work in Europe which was previously under the administration of the International Education Board Dr Lauder W Jones of Princeton University has been

appointed associate director for the natural sciences of the Rockefeller Foundation Dr Jones assumed his duties at the beginning of April and will have his headquarters in Paris, carrying on the work as successor to Dr Augustus Trowbridge

The Salters' Institute of Industrial Chemistry is again offering a limited number of fellowships to chemists of post graduate standing, the object being to afford additional and special training at home and abroad, preparatory to a career in industrial chemistry The value of each fellowship will be from £250 to £300, and applications must reach the director of the Institute, Salters' Hall, St Swithin's Lane, E C 4, not later than June 1 The Salters' Institute will in July allocate a limited number of grants in aid to young men and women employed in chemical works in or near London who desire to extend their education for a career in chemical industry The latest date for the receipt of applications is June 7

A number of studentships — 'research' and 'advanced study'—not exceeding ten in all, are being offered by the Empire Cotton Growing Corporation for the purpose of (a) enabling graduates who believe that they have a leaning towards research to equip themselves for posts in which work of that type is required, and (b) enabling men to receive such specialised instruction as their previous qualifications and experience show to be most desirable in order to equip them for agricultural posts in cotton growing countries wherever opportunities for employment may present themselves The value of each studentship is £250 a year, with certain additional allowances for travelling expenses, books, etc. Forms of application can be obtained from the Secretary, Empire Cotton Growing Corporation, Millbank House, 2 Wood Street, Millbank, S W 1 The latest date for the return of forms is June 4

The Colston Research Society, which exists to assist research work in the University of Bristol by means of money collected annually, has received this year, in addition to the ordinary collection, the sum of £5000 from one of the Society's oldest subscribers, Mr R H Mardon The money is to be maintained intact to provide a fund annually for investigation in agriculture or industry in the University of Bristol which is likely to be of benefit to any portion of the British Empire This is the first permanent endowment which has been received The Colston Research Society was founded thirty years ago, and of recent years has collected annually £700 to £800 Mr Mardon's gift encourages the hope that further endowments may be forthcoming

The Rockefeller Medical Fellowships for the academic year 1929–30 will shortly be awarded by the Medical Research Council, and applications should be lodged with the Council not later than June 1 These fellowships are provided from a fund with which the Medical Research Council has been entrusted by the Rockefeller Foundation and are awarded to graduates who have had some training in research work in the primary sciences of medicine or in clinical medicine or surgery, and are likely to profit by a period of work at a university or other chosen centre in the United States before taking up positions for higher teaching or research in the British Isles In special circumstances the fellowships may be tenable at centres of research not in America A fellowship held in America will have the value of not less than £350 a year for a single fellow, travelling expenses and some other allowances will also be paid Forms of application are obtainable from the Secretary, Medical Research Council, 38 Old Queen Street, Westminster, S W 1

Calendar of Patent Records.

May 14, 1655 —The patent granted to Sir Edward Ford on May 14, 1655, for his method of "drayning of lands, raysing of water to serve citties or houses, as likewise for cleering, drayning, and avoiding of springs from mynes and quarries" is the only one to be found on the Commonwealth patent rolls Ford erected pumps, worked by a horse gin, on a site between Somerset House and Arundel House, opposite the present Surrey Street, for supplying water to London direct from the Thames The pumps remained working for several years, but were ordered to be pulled down by Charles II because "the great fabric of wood" was a nuisance, especially to Denmark House, the residence of Queen Henrietta Maria

May 14, 1825 —Sir Goldsworthy Gurney's steam road carriage, which he patented on May 14, 1825, was provided, in addition to the ordinary piston engine driving the wheels, with adjustable propelling legs which acted successively against the surface of the road to assist the coach up hills A contemporary drawing shows that it was a six wheeled vehicle

May 15, 1824 —The machine for making solid headed pins which was the subject of the English patent granted to the American, Lemuel Wellman Wright (on behalf of a kinsman in the United States), on May 15, 1824, was not the first of its kind to be patented, but was the first to achieve commercial success, though it was many years before pins made by the old process dropped out of the market The manufacture started by the inventor in London failed, but the patent was acquired by Messrs Taylor and Co, of Stroud, Gloucestershire, who spent a large sum of money in perfecting the machine The life of the patent was extended for five years by the Privy Council

May 15, 1832 —The steam plough with stationary engine and cable was patented by John Heathcoat on May 15, 1832 The patent foreshadowed also the use of 'caterpillar' wheels for agricultural machinery To enable the apparatus to be worked on soft ground, the engine was fixed on a carriage of large dimensions and mounted on a series of wheels which conducted "an endless flexible floor, railroad, or way," within and upon which the carriage was caused to travel The 'flexible floor' was made of painted or tarred sail cloth stretched on strips of metal

May 15, 1844 —The first industrial application of gutta percha was in the manufacture of cork stoppers and other articles, and was patented by Charles Hancock on May 15, 1844 The new material only became known in England the previous year, when specimens of it were exhibited for the first time at the Society of Arts

May 16, 1674 —The patent granted for seven years to George Ravenscroft on May 16, 1674, for "his new invention or art and manufacture of a certaine christeline glasse resembling rock christall not formerly used in this kingdome" was a landmark in the history of English glass From it dates the introduction of the flint glass industry of England which dominated the European markets for many years

May 16, 1862 —The bicycle did not become popular until about 1865, when Ernest Michaux of Paris introduced what became generally known as the 'boneshaker,' which had pedals fitted directly to an enlarged front wheel But a notable contribution to its success as a means of transport was made by Albert Louis Thirion, a Belgian resident in London, who on May 16, 1862, was granted in England the first patent for roller or ball bearings for use on velocipedes.

Societies and Academies

LONDON

Royal Society, May 2 — **J S Haldane, W Hancock, and A G R Whitehouse** The loss of water and salts through the skin, and the corresponding physiological adjustments The paper contains data as to the nature and percentage amounts of salts lost from the skin without sweating and in different stages of free sweating The disturbance produced when loss of salts and water is replaced by gain of pure water is ordinarily prevented by the compensatory action of the kidneys and a natural craving for salt What is kept practically constant is the diffusion pressure of water within the body, in accordance with Claude Bernard's conception of the blood as an internal environment maintained constant by the co ordinated action of organs —**F H A Marshall and J Hammond** Œstrus and pseudo pregnancy in the ferret 'Heat' is prolonged in absence of coitus The vulva enlarges to about fifty times its anœstrous size and persists to cessation of heat Ovulation occurs at any time during heat, but only after coitus Details are given of the uterine changes All changes are apparently controlled by the corpus luteum The vulva affords no external indication of the luteal phase which is the main factor in the developmental changes – **R G Canti and F G Spear** The effect of gamma irradiation on cell division in tissue culture *in vitro* The fall in the number of cells undergoing mitosis was followed by a rise which, with a certain exposure and intensity, was com pensatory to the fall With longer exposures, though there was a tendency to rise, the number of cells undergoing mitosis never reached the normal —**R B Bourdillon, C Fischmann, R G C Jenkins, and T A Webster** The absorption spectrum of vitamin D By the action of ultra violet radiation on ergosterol three substances (or groups of substances) are produced in succession The first shows an absorption band roughly similar to that of ergosterol (maximum 280$m\mu$), but more than twice as intense, and has great anti rachitic activity It is probably vitamin D Neither the second nor the third substance has antirachitic activity, though the former shows a strong absorption band at 240$m\mu$ The actual percentage of vitamin D present in the purest preparations studied is estimated as above 50 —**G E Briggs**. Experimental researches on vegetable assimilation and respiration (20) — **R J Lythgoe and K Tansley** The relation of the critical frequency of flicker to the adaptation of the eye The critical frequency due to the cones falls during dark adaptation and with decreasing levels of light adaptation and is highest with equally bright surrounds That due to the rods behaves in the opposite fashion The peripheral cones are function ally not identical with the foveal cones The bright ness of the surrounds is the most important factor in determining whether the critical frequency relations are of the rod or cone type, bright surrounds en couraging the cones and dark surrounds the rods — **R Hill** Reduced hæmatin and hæmochromogen — **G R. de Beer** The development of the skull of the shrew —**J W Pickering** The influence of Witte's 'peptone', and of digestion on blood platelets and plasma —**F W R Brambell and A S Parkes** Com pensatory hypertrophy of the untreated ovary after unilateral X ray sterilisation —**W Moppett** The differential action of X rays in relation to biology, chemistry, and physics (Part 1) —**C H Browning, J. B Cohen, S. Ellingworth, and R Gulbransen** The trypanocidal action of some derivatives of anil and styryl quinoline

PARIS

Academy of Sciences, April 8 —**P Villard** The devitrification of glass Experiments are described leading to the conclusion that devitrification of glass is the consequence of a loss of sodium or potassium, and practical suggestions are made for working glass before the blowpipe so as to reduce devitrification to a minimum —**G Vranceanu** The three points of view in the study of non holonome spaces —**Georges Giraud** The solution of the problem of Dirichlet for linear equations – **Krawtchouk** The approximate solution of linear integral equations —**Mlle Nina Bary** Some mixed forms of the finite representation of an arbitrary continuous function —**J A Lappo-Dani-levski** Fundamental problem of the theory of functions in the class of matrices satisfying systems of differential equations with rational coefficients — **Benjamin Meisel** The approximate definition of the relative kinetic energy of a liquid filling a rotated vase —**E Sevin** The Compton effect and its inverse — **Antoine Willemart** The absorption spectra of the rubrenes Curves are given of the absorption spectra of the three known rubrenes, rubrene, dimethyl rubrene, and bibenzorubrene Each has the same number of bands similarly placed, and the three maxima on each curve have identical wave lengths — **H Damianovich and J J Trillat** Researches on the action of helium on platinum Under the influence of an electric discharge at low pressure, platinum re tains large quantities of helium Examination of the substance produced by means of the X rays, using the Debye Sherrer method, did not give very definite re sults, but there were some indications of the presence of a new micro crystalline compound probably a combination of helium and platinum – **Galibourg** The effect of extension and ageing on the elastic limit of metals —**J Cournot** The influence of the dimen sions of the test pieces in measurements of the vis cosity of metallurgical products The dimensions of the test piece have a marked influence on the flow of the metal the practical limit of the viscosity in creases with the diameter of the test piece Data are given for aluminium wires —**Lespieau and Wiemann** The preparation of acetylenic hydrocarbons with the aid of epidibromhydrins Details of the products of the reaction between methyl magnesium bromide and the epidibromhydrin containing five atoms of carbon —**V Agafonoff** The determination of the mass of carbon and constitutional water contained in the soils of the terrestrial globe —**Henry Hubert** The monthly rainfall curves at Madagascar —**Guilliermond** New remarks on the Golgi apparatus the Golgi apparatus in the yeasts Additional proofs, with illustrations, are given of the author's view that there exists no Golgi apparatus independent of the chondriome and the vacuome —**L Marrassé** Hexamethylenetetra mine and formaldehyde are true foods for the bean The conclusions of E and G Nicolas, based on the method of cultures, are confirmed by a cytophysio logical method hexamethylenetetramine and formal-dehyde, in proportions of 0 2 per thousand of the former and 0 16 per thousand of the latter, form true foods for the cells of the bean —**I D Strelnikov** The fauna of the Sea of Kara and its ecological conditions – **G Frank and M Popoff** The mitogenetic radiation of the muscle in contraction The mitogenetic radia tion can only be the product of the explosive glycolysis which occurs precisely at the period of latent irrita tion and at the commencement of the contraction — **P Delanoë** The presence of the *Ornithodorus* of Morocco in the burrows of porcupines and foxes and in human habitations Its existence in eastern Morocco Frequency of a recurrent spirochæte in the *Ornitho-dorus* of these burrows

GENEVA

Society of Physics and Natural History, Feb 21 — **E Cherbuliez and P Plattner** A new method of separation of the amino acids in the form of their acetyl esters The principles of this separation are as follows (1) hydrolysis by hydrochloric or sulphuric acid at the boiling point, (2) esterification of this solution by alcoholic hydrochloric acid, (3) acetylation of the syrup obtained by concentrating the solution of the hydrochlorides of the esters by treatment with acetic anhydride and sodium acetate in excess —**E Cherbuliez and S Ariel** A new method of disintegrating the proteids and the problem of the size of the molecules of the scleroproteins The authors have studied the solubility of the following scleroproteins in acetamide at 200° C and in urea at 140° C fibroin, keratin (dog's hair, ox hair), elastin (ox) The latter is insoluble in both solvents at the temperatures given above, the keratins are both soluble, the fibroin soluble in urea and partially soluble in acetamide (28 per cent in 30 minutes) The process of solution is accompanied by a profound modification of the chemical character of the proteids utilised, and this is probably due to an intramolecular transposition —**G Dejardin** The progress realised in the preparation and use of thermionic cathodes The author describes particularly the cathodes consisting of a metallic nucleus with a superficial layer, probably monatomic, of another metal The cathode nucleus is a tungsten wire covered superficially with an oxide, such as copper oxide, susceptible of being reduced by barium vapour at a moderately high temperature The barium salt of hydrazoic acid, BaN_6 is utilised —**R Chodat** The theory of generalised mutation and mutations in *Chlorella rubescens* By cultures derived from a single cell, carried out with the micromanipulator of Janse and Peterfi, the author ascertains from several generations that the general law is not constancy but micromutation In the colonies, the micromutants are, as it were, merged in the whole and escape observation —**Arnold Pictet** The reconstitution of a dominant character by crossings between recessives —**Ed Parejas** Geological observations in Corsica (2) The autochtone sediment of Popolasca At Popolasca, the Mesozoic presents facies comparable with those of Malm and of the Helvetian Infravalanginian (autochtone of Gastern and Doldenhorn stratum) One of these limestones contains authigen albite A thin layer of granite not hitherto pointed out overlaps the series of Popolasca —**G Tiercy** Concerning the gain and loss of chronometers (2) To the considerations developed in an earlier note, where the author gives the relation correction = -(rate) he adds some further remarks taken from the meaning attributed to the word 'etat' in finance and in rational mechanics He stresses the fact that the word 'etat' (rate) is employed in relation to watches, not only at the Geneva Observatory but also at Kew and at Besançon

ROME

Royal National Academy of the Lincei, Jan 20 — **F Severi and B Segre** Further with regard to a topological paradox (2) —**G Giorgi and Ernesta Porcu-Tortrini** Motions of deformation in space represented by means of matrix calculus —**U Cisotti** The triple tensor of Christoffel —**F Zambonini and Silvia Restaino** Double sulphates of the rare earth and alkali metals (12) Cerous and cæsium sulphates Study of the isotherm of the system, $Ce_2(SO_4)_3$ – Cs_2SO_4 – H_2O, at 25° indicates the existence of the compound $Ce_2(SO_4)_3$, Cs_2SO_4, $8H_2O$, which is stable within moderately wide limits —**S Franchi**: Non existence of the great faults known as the Monte Rosa bowl and of the Great St Bernard bowl in the Western Alps Study of the tectonics of the Franco Italian Cottian Alps indicates that the Monte Rosa bowl (V) and the Great St Bernard bowl (IV) have no real existence, and that, in the western Alps, the contact between the permian, attributed to fold IV, and the calc schisto, attributed to V, is a normal contact —**B Segre** Construction of a simple oblique Jordan's curve —**A Mambriani** A particular differential equation Scorza Dragoni has recently indicated briefly the method, to be published fully later, used to demonstrate the existence and unicity of the solution of the differential equation, $y'' = yt\ x^{-\frac{1}{2}}$, with the limiting conditions $y(0) = 1$, $y(+\infty) = 0$, which arises from certain physical investigations of Fermi It is now shown that the existence and unicity of the equation in question may be deduced at once from classical propositions on ordinary differential equations, in conjunction with elementary observations on the particular form of the equation —**Rita Liceni** The form F_2 of Fubini For the surfaces in a four dimensional space S_4, Fubini found a form indicated by him by F_2 which has a projective character Later, in the study of certain varieties, Vitali encountered a form F_2, also of projective character, and showed that, in the case of the surfaces in S_4, his F_2 coincides with that of Fubini The author now develops the analytical passage from one form to the other —**J Kaucký** Sur faces of which a canonical straight line passes through a fixed point —**F Cecioni** Conform representation of pluri-connected areas belonging to a Riemannian surface —**A M Bedarida** Systems of arithmetical progressions —**G Krall** Upper limitations for the dynamic displacement in elastic systems Higher limits are assigned to the displacement of an elastic body, vibrating under the action of either constant or time variable forces, starting from the more general initial circumstances of the motion —**A Carrelli** The new diffusion phenomenon the Raman effect It is shown that, as for Tyndall light, the intensity of Raman light is directly proportional to the fourth power of the emitted frequency and is dependent also on magnitudes characteristic of the lines in the dispersion formula of the substance considered —**T G Levi** Dithioformic acid (2) Various derivatives of dithioformic acid, obtained by the action of chloroform on potassium sulphide The acid, now isolated in the pure form as a white solid melting and decomposing at 55° 60°, decomposes into hydrogen sulphide, carbon disulphide, carbon, and sulphur, when heated The results of molecular weight determinations indicate that the acid and its esters exist as trimerides, and a cyclic structure with alternate carbon and sulphur atoms is suggested Two isomeric benzyl esters exist, the isomerism being probably of the cis trans type —**F Rodolico** Crystallographic investigations on cinnabar from Idria

VIENNA

Academy of Sciences, Feb 21 —**E Beutel and A Kutzlnigg** The action of potassium ferrocyanide on silver and some slightly soluble silver compounds —**W Leithe** The natural rotation of polarised light by optically active bases (2) The rotation of *d* α-phenyl ethyl amine and its chlorhydrate in solution, with remarks on the rotation of active tetra-hydroquinaldine —**E Haschek** A contribution to the theory of photochemical phenomena Concerning the retina of the eye —**K. Schnarf** The embryology of Liliaceæ and its systematic significance —**M Holly** Three new fish forms from Persia *Barbus* and others, including a cyprinodon from warm springs.

Official Publications Received.

BRITISH

The Tea Research Institute of Ceylon Bulletin No 3 Annual Report for the Year 1928 Pp 67+3 plates. (Kandy)

Memoirs of the Department of Agriculture Trinidad and Tobago No 4 The Useful and Ornamental Plants of Trinidad and Tobago By W G Freeman and R. O Williams Second edition revised Pp. iv+192 (Trinidad B W I Government Printing Office Port of Spain)

Ceylon Journal of Science Section A Botany Annals of the Royal Botanic Gardens Peradeniya. Edited by A H. G Alston Vol 11 Part 2 March 12th Pp. 113 211+plates 16 24 (Peradeniya Director of Agriculture, London Dulau and Co., Ltd) 3 rupees

The Indian Forest Records. Entomology Series Vol 13 Part 5 Epidemic Attacks by the Sal Heartwood Borer (*Hoplocerambyx Spinicornis* Newm fam Cerambycidae) in the Forests of South Mandla Division, Northern Circle Central Provinces with special reference to the Period 1924-25 *to* 1926-27 By Wm Angus Muir Pp ii+76+12 plates (Calcutta Government of India Central Publication Branch) 2 10 rupees 4s. 9d

British Museum (Natural History) Picture Postcards Set F29 British Trees Smooth leaved Elm 2 cards in Colour and 2 in Monochrome. 6d. Set F30 British Trees Wych Elm 2 cards in Colour and 2 in Monochrome 6d Set F31, British Trees Scotch Fir 2 cards in Colour and 2 in Monochrome 6d. Set F35 British Trees Common Oak 2 cards in Colour and 2 in Monochrome 6d Set F37 British Trees Hazel 2 cards in Colour and 2 in Monochrome 6d (London British Museum (Natural History))

Australia Commonwealth Forestry Bureau Third British Empire Forestry Conference Australia and New Zealand 1928 Papers Presented Pp 905 Commonwealth Handbook Pp 42 Summary Report Resolutions and Reports of Committees Pp 67 (Canberra F C T H J Green)

Empire Forestry Conference, Australia and New Zealand, 1928 Forestry Handbook for New South Wales Pp 48 (Sydney N S.W Alfred James Kent.)

Report of the Kodaikanal Observatory for the Year 1928 Pp 4 (Calcutta Government of India Central Publication Branch)

Education (Scotland) Report for the Year 1928 by the Director on the *Royal Scottish Museum Edinburgh* *Pp. 9* (Edinburgh.)

The Journal of the Institution of Electrical Engineers Edited by P F Rowell Vol 67 No 388 April Pp 437 556+xxxvi (London E and F N Spon Ltd) 10s 6d.

Air Ministry Aeronautical Research Committee. Reports and Memoranda No 1190 (Ae 352) Wind Tunnel Experiments on the Design of an Automatic Slot for R A F 31 Section By F B Bradfield and F W G Greener (T 2656) Pp. 11+5 plates (London H M Stationery Office) 9d. net

Reorganisation and the Teaching Profession Being a Statement supplementary to the Hadow Report and After, by the Executive of the National Union of Teachers upon some of the Professional Problems which arise in connection with the Reorganisation of Public Elementary Schools now Proceeding Pp 32 (London National Union of Teachers) Free

World's Poultry Congress Crystal Palace London England July 22 30 1930 Preliminary Announcement. Pp 24. (London Ministry of Agriculture and Fisheries)

History of the West Kent Scientific Society (1852 1921) By John M Stone Revised to 1928 and including List of Past Presidents and Secretaries (London Hon Secretary 15 St. German's Place S E 3)

Proceedings of the Royal Society of Edinburgh Session 1928-1929 Vol. 49 Part 1 No. 7 The Correlation between Product Moments of any Order in Samples from a Normal Population By Dr John Wishart Pp. 78-90 1s Vol 49 Part 2, Nos 10 11 12 Studies in Embryonic Mortality in the Fowl 1 The Frequencies of various Malpositions of the Chick Embryo and their Significance by F B Hutt ii Chondrodystrophy in the Chick, iii Chick Monsters in relation to Embryonic Mortality by F B Hutt and Dr A W Greenwood Pp 118 155+5 plates 5s Vol. 49 Part 2 No 13 The Hydrogen Chlorine Flame By Dr E B Ludlam H G Reid and G S Soutar Pp. 156 159+1 plate 9d. (Edinburgh Robert Grant and Son London Williams and Norgate, Ltd)

University of Leeds Publications and Abstracts of Theses by Members of the University during Session 1927 28. *Pp* 31 (Leeds)

The Scientific Proceedings of the Royal Dublin Society Vol 19 N S No 19 Coniferae Keys to the Genera and Species with Economic Notes. By H M. FitzPatrick Pp 189 260+plates 9-15 (Dublin Hodges Figgis and Co. London Williams and Norgate Ltd) 8s

Canada. Department of Mines Mines Branch Investigations of Mineral Resources and the Mining Industry 1927 (No. 694.) Pp. iv+60 (Ottawa F A. Acland.)

The Hudson Bay Region. By F H Kitto. Pp vii+50 (Ottawa Department of the Interior Natural Resources Intelligence Service London High Commissioner for Canada.)

Journal of the Federated Malay States Museums. Vol 8 Results of an Expedition to Korinchi Peak Sumatra. Part 3 Invertebrates. Pp 175 304. (Kuala Lumpur) 50 cents 1s 6d

Queensland. Department of Mines Geological Survey of Queensland Publication No 276 Geology of the Bowen River Coalfield By J H Reid Pp. viii+107 (Brisbane Anthony James Cumming)

Abstracts of Dissertations approved for the Ph.D M Sc. and M Litt. Degrees in the University of Cambridge for the Academical Year 1927–1928 Published by Authority Pp 85 (Cambridge At the University Press.)

The National Physical Laboratory Report for the Year 1928. Pp. vi+283+12 plates. (London H M Stationery Office.) 9s net.

The Welsh Journal of Agriculture the Journal of the Welsh Agricultural Education Conference. Vol 5 Pp. 360. (Cardiff University of Wales Press Board) 3s. 6d

Union of South Africa. Report of the South African Museum for the Year ended 31st December 1928. Pp. ii+12 (Cape Town.)

Committee of Civil Research Radium Sub-Committee Report. (Cmd 3303.) Pp. 31 (London H M Stationery Office) 6d. net

Journal of the Indian Institute of Science. Vol. 12A, Part 1 Phototropic Compounds of Mercury By Bh S. V Raghava Rao and H E Watson. Pp 16. 1 rupee Vol 12A Part 2 Photoelectric Emission from Phototropic Mercury Compounds By Bh. S V Raghava Rao and H E Watson. Pp. 17 29 12 annas Vol 12A Part 3 Attempts to Synthesise *Ortho* thiolphenylhydrazine By Praphulla Chandra Guha and Tajendra Nath Ghosh Pp. 31 35 6 annas Vol 12A Part 4 i. Characterisation of *very* small Quantities of Proteins by Van Slyke's Method by Nuggihalli Narayana and Mothnahalli Sreenivasaya ii The Determination of Pyruvic Acid by Basettihalli Hanumantha Rao Krishna and Mothnahalli Sreenivasaya Pp 37 51 12 annas (Bangalore.)

Department of Scientific and Industrial Research Building Science Abstracts Compiled by the Building Research Station and published in conjunction with the Institute of Builders Vol 2 (New Series), No. 3, March Abstracts Nos 400 89 Pp v+97 182 (London H.M Stationery Office) 9d net

FOREIGN

Smithsonian Miscellaneous Collections Vol 81 No 8 Parasites and the Aid they give in Problems of Taxonomy Geographical Distribution and Palaeogeography By Maynard M Metcalf (Publication 3010) Pp 36 Vol 81 No 11 Atmospheric Ozone its Relation to some Solar and Terrestrial Phenomena. By Frederick E Fowle (Publication 3014) Pp 27 (Washington D C Smithsonian Institution)

Department of the Interior U S Geological Survey Bulletin 797 C Preliminary Report on the Sheenjek River District Alaska By J B Mertie Jr (Mineral Resources of Alaska 1926-C) Pp ii+99 123+1 plate 10 cents Bulletin 797 D Surveys in Northwestern Alaska in 1926 By Philip S Smith (Mineral Resources of Alaska 1926 D) Pp ii+125 142+1 plate 5 cents Bulletin 805 A Platinum and Black Sand in Washington By J T Pardee (Contributions to Economic Geology 1928 Part 1) Pp ii+1 5 cents Bulletin 810 A Mineral Industry of Alaska in 1927 and Administrative Report By Philip S Smith (Mineral Resources of Alaska 1927 A) Pp ii+85+xiii Water Supply Paper 589 Surface Water Supply of the United States 1924 Part 9 Colorado River Basin Pp v+169 25 cents Water Supply Paper 597 A Geology of Reservoir and Dam Sites with a Report on the Owyhee Irrigation Project Oregon By Kirk Bryan. (Contributions to the Hydrology of the United States 1928) Pp iv+72+10 plates 30 cents (Washington D C Government Printing Office)

State of Illinois Department of Registration and Education Division of the Natural History Survey Bulletin Vol 17 Art 12 The Bottom Fauna of the Middle Illinois River 1913 1925 its Distribution Abundance Valuation and Index Value in the Study of Stream Pollution By R. E Richardson Pp 386 475 (Urbana Ill)

Smithsonian Institution Bureau of American Ethnology Bulletin 84 Vocabulary of the Kiowa Language By John P Harrington Pp. v+255 (Washington D C Government Printing Office) 75 cents

State of Connecticut State Geological and Natural History Survey Bulletin No 44 Report on the Water Resources of Connecticut By Prof Roscoe Henry Suttie (Public Document No 47) Pp 168 (Hartford Conn)

Bernice P Bishop Museum Bulletin 50 The Breadfruit of Tahiti By Gerrit Parmile Wilder Pp 83 Bulletin 51 Fossil Marine Mollusks of Oahu By Jens Mathias Ostergaard Pp 32+2 plates. Bulletin 52 Cornaceae and Allies in the Marquesas and neighboring Islands By Forest B H Brown (Bayard Dominick Expedition Publication No 18.) Pp 22 Bulletin 53 Archaeology of Nihoa and Necker Islands By Kenneth P Emory (Tanager Expedition Publication No 5) Pp 124+23 plates Bulletin 54 String Figures from Hawaii including some from New Hebrides and Gilbert Islands By Lyle A Dickey Pp. 169+2 plates Bulletin 55 Fringing and Fossil Coral Reefs of Oahu By James B Pollock Pp 56+6 plates Bulletin 56 Check List of Hawaiian Land and Fresh Water Mollusca By Edward L Caum Pp 79 Bulletin 57 Report of the Director for 1927 By Herbert E Gregory Pp 38 Memoirs of the Bernice P Bishop Museum Vol 10 The Fishes of Oceania By Henry W Fowler Pp ii+540+49 plates (Honolulu Hawaii)

Meddelanda från Lunds Astronomiska Observatorium Ser 2, Nr 52 On the Distribution of the Apparent Magnitudes of the Foreground Stars of Dark Nebulae By W Gyllenberg Pp. 25 (Lund C W K Gleerup.)

Publications of the Astronomical Institute of the University of Amsterdam. No 2 Researches on the Structure of the Universe By A Pannekoek 2 The Space Distribution of Stars of Classes A, K and B derived from the Draper Catalogue 3 The Cape Photographic Durchmusterung Pp ii+87 (Amsterdam)

United States Department of Agriculture Technical Bulletin No 89 Biology of the European Red Mite in the Pacific Northwest By E J Newcomer and M A Yothers Pp 70 (Washington D C Government Printing Office.) 15 cents

Zoologica Scientific Contributions of the New York Zoological Society Vol 10 No 1 The Fishes of Port au Prince Bay Haiti with a Summary of the known Species of Marine Fish of the Island of Haiti and Santo Domingo By Dr William Beebe and John Tee Van Pp. 279 (New York City)

Smithsonian Miscellaneous Collections Vol 81, No 10 Tropisms and Sense Organs of Lepidoptera. By N E McIndoo. (Publication 3013) Pp. 59 (Washington D C. Smithsonian Institution)

Ministry of Public Works, Egypt Physical Department. The Measurement of the Discharge of the Nile through the Sluices of the Aswan Dam Final Conclusions and Tables of Results By Dr H E Hurst and D A F Watt. (Physical Department Paper No. 24) Pp v+44+5 plates (Cairo Government Press.) 10 P T

CATALOGUES.

Catalogue of Books on Chemistry and Chemical Technology Pp 56 (London H K. Lewis and Co., Ltd)

Zenith Resistances and Rheostats Pp 36+16+12 (London Zenith Electric Co, Ltd)

Photography in Comfort Pp 36. (London Burroughs Wellcome and Co)

Diary of Societies

FRIDAY MAY 10

ROYAL ASTRONOMICAL SOCIETY at 5 — Prof E Hertzsprung The Pleiades (George Darwin Lecture) —E A. Kreiken On the Dwarf Nature of Double Stars

PHYSICAL SOCIETY (at Imperial College of Science) at 5 —Dr W E Sumpner Heaviside s Fractional Differentiator —J H Awbery A Simple Method of Fitting a Straight Line to a Series of Observations.—E W H Selwyn Arc Spectra in the Region λ1600–λ2100 —Dr K R Rao The Spectrum of Trebly ionised Thallium —G A Wedgwood The Elastic Properties of Thick Cylindrical Shells under Internal Pressure —A Demonstration relating to Standards of Length and Mass by J E Sears

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (at Abbey Hotel Kenilworth) at 5 30 —Discussion on Stare Bridge D H Brown Kenilworth Castle and Town S Douglas

ROYAL SOCIETY OF MEDICINE (Clinical Section), at 5 30 —Annual General Meeting

MALACOLOGICAL SOCIETY OF LONDON (in Zoological Department, University College) at 6

INSTITUTION OF MECHANICAL ENGINEERS at 6 —Special General Meeting

ROYAL SOCIETY OF ARTS (Indian Meeting), at 8 —Captain P Johnston Saint An Outline of the History of Medicine in India (Sir George Birdwood Memorial Lecture).

SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (Annual General Meeting) (at Victoria Hall Criterion Restaurant) at 8 30 —Discussion on How can the Chemical Engineering Group best assist in the Development of the Science and Practice of Chemical Engineering?

ROYAL INSTITUTION OF GREAT BRITAIN at 9 —Prof A E Boycott The Twist of Snail Shells

SATURDAY MAY 11

BIOCHEMICAL SOCIETY (in Department of Biochemistry University Museum Oxford) at 2 —K H Coward K M Key, and B G E Morgan Some Evidence of the Existence of a Further Factor Necessary for Growth of the Rat.—H Bainbridge E Boock, and J Trevan The Growth of Rats on Synthetic Diets —C R Harington and D A Scott Observations on Insulin —F H Carr K Culhane A T Fuller and Dr G W F Underhill A Reversible Inactivation of Insulin —W I Dilière R H Morton and Dr J C Drummond The Alleged Relation between Carotene and Vitamin A —H J Phelps The Mechanism of the Adsorption of Weak Electrolytes —H W Kinnersley and R. A. Peters Observations upon Carbohydrate Metabolism in Avitaminous Birds —R. A Peters The Third Factor of Williams and Waterman —B Woolf The Enzymes in *B. coli communis* which act on Fumaric Acid E Boyland The Lag between Phosphate Esterification and Carbon Dioxide Evolution in Alcoholic Fermentation —Demonstrations —Tachycardia in Rice fed Pigeons by C W Carter and R. A Peters —Blood Testing by Dr G L Peskett.

BRITISH PSYCHOLOGICAL SOCIETY (at Royal Anthropological Institute) at 3 —Miss E H. Walters Is there a Common Factor of Sensorial Retentivity and is it Influenced by Conation?—S. E W Taylor A Balance Showing the Relation of Blood Distribution to Mental Activity —J W Caughey Some Factors Involved in the Performance of Single Routine Tests

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (South Wales District) (at Council Chamber Swansea) at 2 15 —Discussion on Some Road and Other Schemes at Swansea R. Hutson Swansea Main Drainage Scheme and Flood Relief Schemes, J Hassall Llansamlet Sewage Pumping Scheme Swansea, M E. Habershon

ROYAL SOCIETY OF MEDICINE (Balneology and Climatology Sections) (at Harrogate).—Annual Meeting

MONDAY MAY 13

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30. —E B Worthington The Life of the Albert Nyanza and Lake Kioga

TUESDAY MAY 14

PHYSICAL SOCIETY (jointly with Society of Glass Technology) (in Research Laboratories of the General Electric Co. Ltd Wembley), at 4 —Prof W E S Turner and F Winks A Study of the Thermal Expansion of Glass up to the Softening Temperature —R. F Proctor and R W Douglas The Measurement of the Viscosity of Glass at High Temperatures by Means of the Rotating Cylinder Viscometer —F C Harris The Photo-Elastic Properties of Glass.

ROYAL SOCIETY OF MEDICINE (Therapeutics and Pharmacology Sections) at 5 —Annual General Meeting

INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5 30 —G B. Maxwell and Dr R. V Wheeler Flame Characteristics of Pinking and Non Pinking Fuels Part II

INSTITUTION OF CIVIL ENGINEERS, at 6.—Annual General Meeting

ILLUMINATING ENGINEERING SOCIETY (at Home Office Industrial Museum Horseferry Road) at 6 45 —G H Wilson The International Commission on Illumination and the International Congress held in the United States in 1928.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN at 7 —J A Speed Flashlight in Natural History Work.

QUEKETT MICROSCOPICAL CLUB, at 7 30 —Dr H A. Baylis Life histories of Parasitic Worms

ROYAL SOCIETY OF MEDICINE (Psychiatry Section) (Annual General Meeting), at 8 30 —Dr F L Golla Some Recent Work on the Pathology of Schizophrenia —Dr W M. F Robertson Gastro intestinal Focal Infection in Relation to Oral Sepsis, with Special Reference to Anaerobes occurring in 6 Cases of Mental Disorder

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8 30 —Dr A F Ashley Montagu The Tarsian Hypothesis in the Descent of Man

WEDNESDAY MAY 15

SOCIETY OF GLASS TECHNOLOGY (at University College), at 2 30.—Prof W E S. Turner The Glass Industry of North America in 1929

IRON AND STEEL INSTITUTE (in Mappin Hall Sheffield), at 2 30.—The Hon Sir Charles Parsons and H M Duncan A New Method for the Production of Sound Steel.—Third Report on Heterogeneity of Steel Ingots by a Committee of the Institute —G A. Hankins and Miss G W Ford The Mechanical and Metallurgical Properties of Spring Steels as Revealed by Laboratory Tests —L B Pfeil The Oxidation of Iron and Steel at High Temperatures —G R Bolsover Brittleness in Mild Steel —H Sutton The Influence of Pickling Operations on the Properties of Steel.

ROYAL METEOROLOGICAL SOCIETY at 5 —J E Clark I D Margary R Marshall and C J P Cave Report on the Phenological Observations in the British Isles December 1927 to November 1928 —D Brunt The Index of Refraction of Damp Air, and the Optical Determination of Lapse rate —Dr J R Ashworth The Influence of Smoke and Hot Gases from Factory Chimneys on Rainfall

ROYAL SOCIETY OF ARTS at 8 —R. Burrell The Reform of the British Patent System

EUGENICS SOCIETY (at Linnean Society), at 8

FOLK LORE SOCIETY (at University College), at 8 —Dr M Taylor Norfolk Folk Medicine

ROYAL MICROSCOPICAL SOCIETY at 8 —E Heron Allen and A Earland Some New Foraminifera from the South Atlantic No I —R. Paulson The Form of the Chromatophore of the Bright Green Gonidium common to many Lichens —D Bryce On Three Cases of Encystment among Rotifers

ROYAL SOCIETY OF MEDICINE (Tropical Diseases Section) (Annual General Meeting) at 8 15 —Prof Besredka Vaccine Therapy

SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) —Annual Business Meeting

THURSDAY MAY 16

LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5 —Prof C G Darwin The Refraction and Scattering of Light (Lecture).

INSTITUTE OF PATHOLOGY AND RESEARCH (St Mary's Hospital) at 5 —Prof F T G Hobday The Value of Research into Animal Diseases as an Aid to the Study of the Diseases of Man

INSTITUTION OF MINING AND METALLURGY (at Geological Society of London), at 5 30

INSTITUTION OF ELECTRICAL ENGINEERS (Irish Centre—Dublin) (at Trinity College Dublin) at 7 45 —Annual General Meeting

CHEMICAL SOCIETY at 8.—Prof T M Lowry The Validity of Drude s Equation —A I Vogel The Dissociation Constants of Organic Acids Part I The Primary Dissociation Constants of some Alkyl Malonic Acids —Prof T M Lowry and W V Lloyd The Properties of Nicotine and its Derivatives Part I Molecular Extinction coefficients Part II Optical Rotatory Power and Rotatory Dispersion —A I Vogel The Dissociation Constants of Organic Acids. Part II The Primary Dissociation Constants of some Cyclo 1 1-dicarboxylic Acids

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (at 11 Chandos Street W), at 8 15 —Dr V Hodson Pulmonary Tuberculosis in the Tropics followed by a Discussion by Col. S L. Cummins and others

BRITISH INSTITUTE OF RADIOLOGY (Annual General Meeting), at 8.30 —Dr G W C Kaye and W Binks The Evaluation of the Pastille Dose in r Units —Dr G W C Kaye and W F Higgins An Instrument for the Rapid Visual Identification of Radium Tubes and Needles

FRIDAY MAY 17

ROYAL SANITARY INSTITUTE (at Town Hall Devizes), at 5 30 —R. T Rhodes and others Discussion on The Milk and Dairies Order 1926 —L B Densham and others Discussion on Meat Inspection

ROYAL PHOTOGRAPHIC SOCIETY (Pictorial Group Practical Meeting), at 7

SATURDAY MAY 18

ROYAL SANITARY INSTITUTE (at Town Hall Devizes), at 10 A M —H R Hooper and others Discussion on Some Aspects of Local Government on Air Water and Sewerage.—A. W Jakeway and others Discussion on The Devizes Sewage Works and Small Type Refuse Destructor

PUBLIC LECTURES

TUESDAY MAY 14

BIRKBECK COLLEGE, at 5 30 —Lord Justice Sankey Lord Haldane s Life and the Adult Education Movement (Haldane Memorial Lecture).

IMPERIAL COLLEGE OF SCIENCE (Royal School of Mines), at 5 30 —Dr W R. G Atkins The Photo electric and Photo-chemical Measurement of Light with Biological Applications. (Succeeding Lectures on May 15 and 16.)

THURSDAY MAY 16

UNIVERSITY OF BIRMINGHAM at 4 —Dr M B Ray The Spa Treatment of Chronic Non tuberculous Arthritis.

ROYAL SOCIETY OF ARTS, at 5 15 —Sir Norman Walker The Progress of Dermatology over Fifty Years (Malcolm Morris Memorial Lecture)

LONDON HOSPITAL MEDICAL COLLEGE at 5 30.—Prof J J R MacLeod The Physiology of Glycogen. (Succeeding Lecture on May 17)

CONGRESSES.

MAY 15 TO MAY 20.

ROYAL INSTITUTE OF PUBLIC HEALTH CONGRESS (at Zurich).

Section I —State Medicine and Municipal Social Hygiene
Section II —Industrial Hygiene and Industrial Diseases
Section III —Child Welfare, School Hygiene and Women and Public Health
Section IV —Pathology Bacteriology and Biochemistry
Section V —Tuberculosis
Section VI —Climatology and Sports Hygiene
Section VII —Veterinary Medicine and Meat Hygiene.

MAY 15 TO MAY 23.

WORLD POWER CONFERENCE ON COMPLETE UTILISATION OF WATER POWER RESOURCES (at Barcelona) —Subjects to be dealt with —General Hydrological Problems Technical Problems of Water Power Utilisation Economic and Financial Problems Legal Problems Protective Measures and Defence Works of Undertakings.

SATURDAY, MAY 18, 1929

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No. 3107, Vol 123]

The Research Associations

THE Report of the Department of Scientific and Industrial Research for the year 1927–28 (Cmd 3258) devotes considerable attention to the position, in the national economy, of the research associations set up in Great Britain under the ægis of the Department Since 1918, when the first three associations were established, some twenty-six research associations in all have been formed Two of them, relating to the glass and cement industries respectively, have been wound up, and of the twenty four associations still in being, one, the British Iron Manufacturers' Research Association, has not received grant aid from the Department, and its operations were suspended at the close of the first quinquennium and have not, up to the present, been resumed The British Colliery Owners' Research Association, founded in December 1924, has not received grant aid from the Department, and three other associations (Motor and Allied Manufacturers, Motor Cycle and Cycle Car, and Scottish Shale Oil) ceased to receive Government grants at the end of their first quinquennium

It will be remembered that the original scheme of the Department of Scientific and Industrial Research provided grant aid from the million fund, set aside by the Government to promote scientific and industrial research, on the basis of annual grants equivalent to the annual subscriptions of members of the associations The scheme further provided that the grant in aid should be limited in each case to the first five years of the association's life It was assumed or believed that a period of five years would be sufficient to demonstrate effectively that co operative research was of value to industry, and that, as a result of that demonstration, the several industries that had embarked on the experiment would be willing to shoulder thereafter the whole financial burden of maintaining their respective research associations In fact, as the report of the Advisory Council to the Department states candidly, "five years proved too short a time for most of the Associations to establish their reputation by the results of their work"

There need be no surprise at this conclusion, for the first two years of an association's life are necessarily spent mostly in setting up the organisation, gathering together the appropriate scientific staff, securing the buildings and equipment, and planning a comprehensive research programme It would be more than remarkable if, in the remaining three years, the results of any association's

work should be sufficiently striking to convince manufacturers (presumably having little or no previous experience of research applied systematically to their respective industries as a whole) that co operative research was of such immediate and valuable service to industry that it would be a ' business proposition ' for them to bear alone its necessarily high expense St Paul may have been amenable to quick conversion, but the average British manufacturer is, shall we say, less impetuous Indeed, even now, after some ten years experience of the work of the research associations the report of the Advisory Council to the Department says ' It cannot be denied that most of the Associations find it difficult to get the financial support they deserve A subscription to a Research Association is still regarded in many cases as a charitable gift, to be paid with public spirit and private reluctance and to be withheld when funds are scarce "

At the end of the first quinquennium, therefore, the Department, looking the facts in the face, agreed to a continuance of State aid, though on a smaller scale, for a further period of five years The scale of grants was not only smaller but also, in general, it was a descending scale, calculated so that at the end of this second quinquennium the grants would sink to zero The stipulated grant earning subscriptions were correspondingly based upon an ascending scale so that the total income of the association should remain about the same and the association be self supporting at the end of this second period of five years But again, in fact, it was found impossible by many, probably by most, of the associations to fulfil the conditions of this carefully planned, if still heroic, scheme and the Department, again facing the facts realistically and sympathetically, consented to modify in a more generous direction the conditions on which a number of the associations might continue to receive grants during this second quinquennium To the associations, however, the problem remained of what was to happen to them on the termination of this second quinquennium It was doubtful, to say the least, whether the majority of them could become financially self supporting, on an adequate scale, immediately this second grant period ceased

Accordingly, nineteen of the research associations during the past year submitted by deputation a reasoned memorial to the Lord President of the Council, the Earl of Balfour, praying for a continuance of financial assistance by the Department on the pound for pound scale The Lord President was unable, on behalf of the Government, to accept the proposals of the memorialists, but he announced a new policy which goes some way to meeting the difficulties with which the associations are faced When the existing contracts for the second quinquennium come to an end, each association is to be considered on its merits and a subscription income fixed which it will be necessary for the association to obtain from other sources before it is eligible for any grant from the Department Funds obtained from approved sources in excess of this minimum subscription income will be augmented by a grant equal in amount from the Department up to a limit depending on the circumstances of the association

That, stated briefly, is the substance of the Department's policy, in the near future, with respect to grants in aid of the research associations, and it is further evidence of the willingness of the Department, to which attention has already been directed to modify and adapt its policy to new facts and changed circumstances The inflexible attitude of ' What we have said we have said " has been wisely left to political heroes The Advisory Council has been mindful throughout that it has a fiduciary duty to ensure, so far as it may reasonably do so, that scientific and industrial research, in close association with industrial effort, plays its essential part in national recovery

The next few years will show whether the new policy is sufficient to enable the research associations to weather the difficulties of the long period that must still ensue before the indifference and inertia, in this matter of research, of the general body of manufacturers (more particularly perhaps of those engaged in industries that have been hitherto largely run on rule of thumb) can be overcome Obviously, very much will depend, in each case, on the minimum subscription income fixed to qualify for grant The Advisory Council states ' We do not, in any case, intend to fix it lower than an amount which, in our opinion, would be sufficient to maintain the Association in being as a useful nucleus of research The State's contribution would then be used to assist in transforming the nucleus into a well-nourished adult and productive organisation " The associations must take hope from the biological fact that nuclei are generally small, and that it should be well within their powers to provide the funds necessary to maintain an organisation that can satisfy the Department's idea of a useful nucleus The Department has of course a duty to the taxpayers not to put the limit too low it has a corresponding duty to the

cause of industrial research, which its own inclination will prompt it to fulfil, not to put the limit so high as to make it prohibitive

Before or at this point the question naturally arises whether the work already done by the research associations has justified their foundation and the money expended by them On this point the Advisory Council—and it is in the best position to know—says categorically "The main purpose has, in our opinion, already been achieved Co operative research has proved its value, it has come to stay, and we agree with the views expressed in the memorial on the importance of consolidating now the financial position of the Associations" The final report of the Balfour Committee on Industry and Trade, issued on Mar 11, emphasises the importance of progress in scientific research and a clearer line of demarcation between the function of the State and that of industrial undertakings either singly or in co operation In particular, the Committee urges that there should be no relaxation or curtailment of the efforts of the Department of Scientific and Industrial Research, and no withdrawal of financial support on the part of the Government

In connexion with this last recommendation it is worth notice that the late Prof Alfred Marshall, the distinguished economist, in his "Industry and Trade", first published in 1919, specifically recommended public grants to research associations on other and perhaps unusual grounds After pointing out that the research associations are "wholly constructive", he says "But the experience of the ages shows that Associations set up for constructive purposes are in danger of being turned to destructive ends and therefore it may perhaps be to the public interest that some limited contribution should be made from public funds to the support of such Associations, partly in order to facilitate the intervention of public authority in case an association should develop anti social tendencies" The reader may find it interesting to make speculations on the character of these "anti social tendencies" presumed to be latent in the research associations

There is a great area of British industry occupied by numerous medium sized and small firms, directed by strongly individualistic owners, too small to enable industrial research to be prosecuted, on any adequate scale, on an individual basis Despite the modern tendency towards larger aggregations of capital by the fusion of smaller firms, it is likely that a very great field of British industry will continue for long to be represented by these medium sized or small manufacturing units For them the only practicable scheme of industrial research, on a sufficient scale, is co operative research, *i e* the organised co operation of groups of firms to provide the funds and the equipment, both personal and material, for the needed research In this field it is most important to find for Government action the golden mean between policies of *laissez faire* and spoon feeding

Geometry and Relativity

Philosophie der Raum Zeit Lehre Von Prof Dr Hans Reichenbach Pp vi + 380 (Berlin und Leipzig Walter de Gruyter und Co, 1928) 18 gold marks

THE appearance of a work on the philosophy of a branch of mathematical physics by a trained philosopher, who at the same time has a thorough knowledge of mathematical and physical methods and principles, is an event as rare as it is welcome This book by the Berlin philosopher Reichenbach, well known to mathematical physicists by his writings on relativity, is unique and should be in the library of everyone interested in geometry and relativity in their philosophical as well as mathematical and physical aspects, fully deserving a place beside the standard treatises of Bertrand Russell and Whitehead It is divided into three sections, the first on space (120 pages), the second on time (45 pages), and the third on space time (155 pages), whilst there is an appendix (42 pages) on Weyl's extension of Riemannian geometry and the geometrical interpretation of electricity, which forms the basis of a recent paper by the same author on Einstein's new field theory of gravitation and electricity In the brief space available here it is impossible to do full justice to the author's argument, but the following summary may be useful as an indication of the character and scope of this very important work

In the first section the argument proceeds as follows there is no pure intuition *a priori*, all intuition is determined by past experience Non-Euclidean geometry is just as intuitive as Euclidean, but one must not expect to be able to imagine non Euclidean geometry by means of Euclidean elements Experience decides which geometry is valid in actual space, but the decision presupposes an arbitrary correspondence definition (*Zuordnungsdefinition*), which defines the unit of length in a given place and permits of a definition of congruence of lengths in different places by means

of transportable rigid measuring rods Any geometry may be made to agree with the behaviour of actual measuring rods by postulating suitable universal forces, so that the deviations from the selected geometry are made to depend on universal deformations of the measuring rods

In the second section the author develops rather novel views Whilst recognising the fruitfulness of the mathematical conception of space and time as a fourfold, he emphasises the point that thereby time does not lose its special character and become a fourth space dimension The comparison of times, like that of lengths, depends on an arbitrary correspondence definition, which defines simultaneity of events occurring in different places Order in time is determined by the law of causality, for the effect is later than the cause, and we can distinguish the cause from the effect, because small variations in the former produce small variations in the latter, whilst the converse is not true The comparison of time-orders in different places depends upon the propagation of signals, and experience shows that the greatest signal velocity is that of light and is finite, so that to every instant of time at a given place there corresponds a finite interval of time at a second place, in which no instant can be connected with the first by a to-and-fro signal Hence the given instant at the first place may be defined as simultaneous with any one instant of the corresponding time interval at the second place

In the third section the author first discusses space-time manifolds free from gravitation, pointing out that comparison of lengths in relative motion to one another requires a new correspondence definition, which defines the length of a moving segment as the distance between simultaneous positions of its two endpoints Experience shows that material structures, like measuring rods and clocks, conform to the relativistic and not to the classical light geometry, so that they measure 'intervals', not spaces and times Passing on to manifolds with gravitation, the author gives the history of the idea of the relativity of motion from Leibniz to Einstein, pointing out that the very idea of motion is meaningless without a correspondence definition of rest the relative motion of the earth and fixed stars is itself not an absolute fact, but only relative to systems of co-ordinates realisable by means of rigid bodies He then analyses in turn Einstein's principle of equivalence and its hypothetical character, his concept of gravitation and its covariance, and his treatment of the rotation problem and idea that every system of co-ordinates requires its own gravitational field and points out the failure of some of the critics to realise that the relation of cause and effect is invariant, not covariant This analysis of the space time properties of gravitational fields leads the author to the important conclusion that the combined space time order is the order scheme of causal sequences and expresses the causal structure of the world

The final discussion of the general properties of space and time begins with the characterisation of time as that dimension of the space time manifold which determines the direction of the world lines of things distinguished by the preservation of their identity, which direction is also that of the causal sequences Then follows a discussion of the number of dimensions of the space-time manifold, ending with the conclusion that the assertion that physical space has three dimensions is on a par with the assertion that matter exists in three states of aggregation it describes a fundamental fact of the objective world, for which no explanation has yet been found Finally, the author declares that the reality of space and time follows inevitably from his analysis of the problem

The appendix begins with the reminder that Riemannian space presupposes congruence definitions realisable by means of rigid measuring rods and clocks, which can be displaced along different paths without violating their properties of congruence If, however, two measuring rods, congruent at the same place and time, cease to be congruent after displacement to another place by different paths, some displacement law is needed to determine the changes of length and direction due to displacement This can be supplied by the postulate that a certain vector at one point after displacement can be identified with a second given vector at another point—this correspondence defines a displacement process and determines a displacement space (*Verschiebungsraum*), just as the usual congruence definition determines the 'metric space'

In order that the two definitions may lead to mutually consistent results, certain conditions must be imposed we may demand that the displacement law shall have a certain symmetry and thus derive Riemannian space from the most general metric space, or that the displacement of lengths shall be integrable, that is, independent of the path, and thus derive a general Einstein's space, or we may impose both conditions and thus derive Euclidean space The displacement process can be realised by means of rigid measuring rods and clocks, and then it determines a length displacement and a gravitational field, or it can

be realised by means of an electrically charged mass particle, and then it determines a directional displacement and an electromagnetic field But whilst the geometrical interpretation of gravitation given by the length displacement has led to an increase of physical knowledge in the shape of Einstein's theory of gravitation, the geometrical interpretation of electricity given by the directional displacement has not led as yet to any advance in the physical theory of electricity

Geophysics

Handbuch der Experimentalphysik Herausgegeben von W Wien und F Harms Unter Mitarbeit von H Lenz Band 25 *Geophysik* Teil 1 Unter der Redaktion von G Angenheister Pp xiv + 699 (Leipzig Akademische Verlagsgesellschaft m b H , 1928) n p

GEOPHYSICS, like astronomy, is advanced jointly by observation and theoretical discussion, and direct experimental illustration of its phenomena is rarely possible The inclusion of this book in a 'handbook' of experimental physics is therefore slightly anomalous, but the volume is none the less welcome Geophysics is of immense scope, because a wide variety of physical properties have to be examined as regards their distribution over the globe, and in many cases also as regards their variations over long periods of years Observation is the primary necessity, but devotion to this duty creates difficulty owing to the volume of the data accumulated The next task, scarcely less important, is to distil the essential facts from this vast material—a laborious process, involving the systematic comparison of data from many stations and, in some cases, heavy computations upon long series of observations to investigate periodic and other changes The third and, in general, most difficult task is to bring the phenomena thus elucidated into relation with general physics , many hypotheses may have to be examined, sometimes requiring extensive mathematical developments and the extrapolation of laboratory results to extreme conditions of temperature or pressure Frequently, the hypotheses prove totally at fault as regards order of magnitude, while in other cases judgment must be held in suspense because some of the factors involved are not yet capable of measurement

Owing to these difficulties, geophysics makes slow progress, but, as in general physics, the discovery of new fields of observation, and the advance of instrumental technique, are throwing light from new directions upon obscure problems, though also disclosing new mysteries for solution A worker in any special branch of geophysics must, therefore, keep acquainted with the progress made in other branches, as well as with general physics Unfortunately, there is a dearth of books summarising geophysical knowledge, and the present volume is a useful supplement to those that exist

This volume is only the first part of the geophysical section of the 'handbook' (as the series of more than twenty five bulky tomes is curiously called) , since no indication is given of the contents of the further parts, it is impossible to judge the balance of the work, or the extent to which the ground will be covered This first part is devoted mainly to the atmosphere, with the partial exception of the last section, on terrestrial magnetism, which may be intended to achieve the transition from dizzy heights to solid earth" The first quarter (165 pages) of the book, by A Defant, deals with the general dynamics and statics of the atmosphere, apart from its tidal and thermal oscillations—an interesting but little known chapter of geophysics, of which an excellent account (48 pages) is given by J Bartels W Milch summarises the optics of the atmosphere (44 pages), and H Benndorf the electrical phenomena (128 pages) apart from the aurora, which is described by L Vegard (94 pages), and the penetrating radiation (K Büttner, 48 pages) Terrestrial magnetism (158 pages) is dealt with by G Angenheister and J Bartels The book concludes with good indexes of subjects and authors

Owing to the small scale of the book in relation to the wide scope of the subject, the treatment is necessarily brief and general Its value must be judged by the extent to which it indicates the main outlines, results and problems of each section, and by the guidance to the literature which is afforded for those readers who wish to follow up any question in detail In the latter respect the book is somewhat unequal, as is natural in a collective work , in some sections the references are carried up to 1927 or even 1928, the year of publication, while in others there are few so late as 1926, though much of importance has since appeared , a rather long interval seems to have elapsed between the preparation of some of the sections and the publication of the book

The general treatment is good, notably so in some sections, and the book is well illustrated Where controversial or uncertain points are touched on, the position is usually explained with proper reserve Vegard's article on auroræ is the least satisfactory in this respect, since it unduly stresses

his own theory of the auroral spectrum and the upper atmosphere In an addendum inserted during proof correction, McLennan's identification of the green auroral line as due to oxygen is admitted, but the remainder of Vegard's theory, postulating an atmosphere above 90 km, composed of frozen nitrogen crystals upheld electrostatically, is maintained The aurora is still very mysterious but there are probably few physicists who would accept this solution

The conditions in the upper atmosphere are touched on in several sections of the book Defant and Benndorf seem to favour the view that hydrogen is the main constituent above 100 km, though to the reviewer the balance of evidence seems opposed to this conclusion On p 3, Wegener's hypothetical substance geocoronium is mentioned surely this speculation might by now have been allowed to lapse into oblivion, being, as it is, totally at variance with modern atomic physics and the evidence of the mass spectrograph The work of Lindemann and Dobson on the upper air temperature is only briefly mentioned, though their conclusions now seem fairly established by confirmatory evidence drawn from the abnormal propagation of sound to great distances, and from the absorption of solar radiation by ozone But while in a few respects some parts of the book fall short of the thoroughness commonly attributed to German works of reference, it would be wrong to magnify minor faults in a work which as a whole has solid merits and can be recommended as a good general account of the subjects falling within its scope

Spencer's "Sociology"

Descriptive Sociology or Groups of Sociological Facts, Classified and Arranged By Herbert Spencer *Hellenistic Greeks* Compiled and Abstracted upon the Plan organised by Herbert Spencer, by the late Sir J P Mahaffy and Prof W A Goligher (Completed by Prof W A Goligher) Issued by Mr Spencer's Trustees Pp vi+94 (London Williams and Norgate, Ltd, 1928) 63s net

"A LARGE book," said a Hellenistic Greek, "is a large evil" What are we to say of one the dimensions of which are nineteen and a half inches by twelve and a half? It will go into no ordinary shelf, it is awkward at best to handle, the tops of the three parallel columns of small print which fill each page are most inconveniently remote to the myopic The physical difficulties of the format are doubtless imposed by Spencer's belief, which I do not personally share, in the utility of an elaborate chart of tabulated conclusions The book in shape and substance is drawn up according to Spencer's plan and, regarded as a monument *in piam memoriam*, it is well and truly constructed

It would of course be easy, as in all compilations of this scale, to make reviewer's points A few accents have gone wrong, there are some misprints, the bibliography does not, as the preface suggests, mention all the works from which quotation is made In the illustrative passages taken from ancient authors it might be held that for the last period too exclusive reliance has been placed upon Lucian and Plutarch Some of the moderns who are cited might be thought a little old fashioned Did not Rostovtzeff's book appear in time for inclusion among writers on the Imperial period, and why should references be given to the second edition of Dittenberger's "Sylloge", the numbering of which has been superseded by the third? Again, one might catch some little point for example, the belief that Prof Goligher shares with Rohde that oriental influence had something to do with the total veiling of women at Tarsus The gloss becomes unnecessary when it is realised that what we may call severity in veiling varied in different Greek States and that the Theban women, for example, in European Greece wore veils which permitted nothing but the eyes to be seen

These are, however, small and some of them disputable matters No one who has a professional interest in ancient history will refuse his meed of admiration for the wide knowledge, industry, and patience which Prof Goligher has expended on his task At that we might leave it, were we not bound to ask whether the result justifies the very considerable labour which has gone to its achievement Regarded as a memorial to Herbert Spencer the book might earn a favourable verdict, but regarded as a useful contribution to ancient history the answer must be less confident Clearly, it is not intended for cursive reading and will not fall easily into the category of a scholarly presentation of the subject to the general public Of works for the specialist reader there are three useful kinds either we expect them to contain new matter of fact or theory which is the result of original research, or, secondly, we look for the presentation of known facts in a new light, or, thirdly, we are grateful for a handy and complete compilation of facts already known It is in the last category that the book must claim to stand, and here it must be confessed that it is vastly inferior in content as well as in convenience of format to the great dictionaries with which the

classical student of to day is so well supplied From them information more detailed and more complete can be obtained with greater ease and, it may be added, a more structural knowledge of the problems connected with the interpretation of the evidence W R H

Preston's "Heat"

The Theory of Heat By Prof Thomas Preston Fourth edition, edited by J Rogerson Cotter Pp xix + 836 (London Macmillan and Co, Ltd, 1929) 25s net

TO publish a fourth edition of a scientific work thirty five years after the appearance of the first edition is a high tribute to the author, particularly when, as in this instance, no very fundamental change has been made in the scheme of the book It is the more notable in experimental science, since Preston could write in 1894 that "It is but a short time since the pursuit of experimental research was regarded merely as a matter of individual curiosity"

Whilst it is not easy to single out any one specific reason for the active survival of "The Theory of Heat", there seem to be in it several outstanding features which have combined to contribute to its continued usefulness The most essential of these is undoubtedly Preston's singularly clear and accurate style One wishes, in fact, that the first chapter, with its admirable general introduction to the subject, the seventh, on conduction, and the following one on thermodynamics—which is perhaps the best elementary account that has been written, and of which Preston is said to have been justifiably proud—could be obtained separately for examination purposes by students who have no use for the whole volume Another reason is in the time at which Preston wrote The epoch making work of the end of the century on the electron had still to be done, and there can sometimes be sensed in contemporary writings the feeling that the apparent limitations of the scientific horizon were real

Preston, whether or not he subscribed to this view, can scarcely fail to have been aware of it—he took the precaution of pointing out that "any theory, however plausible, may ultimately become untenable"—and he could thus write with greater confidence than if he had started a few years later, when he had become interested in the new physics, and was himself engaged in research on the Zeeman effect. It must also be remembered that he was dealing not only with a subject that appeared to be sound theoretically, but also that even then he had to describe experiments that aimed at, and often attained, considerable precision Again, Preston states that he was attempting "to treat the science of heat in a comprehensive manner", and not "to meet the requirements of some particular class of persons preparing for examinations or engaged in practical pursuits", an ideal which is also realised in Tyndall's earlier "Heat a Mode of Motion" and Kayser's original pygmy "Lehrbuch der Spektralanalyse" of 1883

Mr Cotter's revision of the third edition of Preston's book is chiefly on the experimental side The square brackets which had previously marked off paragraphs which were not parts of Preston's own contribution have been removed Several condensations and omissions have been made, notably in the description of experiments and in discussions of disputed points which have now lost their interest In their places are accounts of some more modern investigations, which have been chosen with discrimination—for example, Stock's realisation of Kelvin's proposed vapour pressure thermometers, and Hercus and Laby's determination of Joule's equivalent—and there are several new references to quantum theory at the appropriate places in the text The book is naturally still far from complete, but it was never intended to be a dictionary of the subject Mr Cotter's task has rather been to retain the spirit and scope of the edition of 1894, but at the same time to make some necessary alterations in parts that were obviously out of date, and in this he has been entirely successful K G E

Our Bookshelf

Anleitung zur chemischen Gesteinsanalyse Von Prof Dr J Jakob (*Sammlung naturwissenschaftlicher Praktika*, Band 15) Pp vii + 81 (Berlin Gebrüder Borntraeger, 1928) 7 gold marks

THE lack of a short but comprehensive work dealing with rock analyses has inspired Prof Jakob to produce this book, which is intended primarily for the use of students in the laboratory It may be placed in the hands of a beginner possessing a sound knowledge of general chemistry, and will enable him to carry out a complete analysis

The author makes a distinction between rock and mineral analyses, each calling for a different method of treatment In a mineral analysis the object is to attain the most accurate result possible, independent of time, with a rock analysis, on the other hand, it is to produce in the shortest possible time a sufficiently accurate result to represent the specimen Any two independent analyses carried out on the same powder show points of divergence, and this is even greater in the case of two portions of

the same rock, hence great accuracy of method is not practical and does not justify the time necessary At the same time, however, Prof Jakob considers that analyses should be more accurate than many quoted in the literature

Directions are given for the preparation of the sample, fineness of grinding, etc , depending on the presence or absence of certain minerals and also on the determination to be carried out The main part of the book deals with the determination of the various oxides, a useful feature of this section being the incorporation of all explanations of processes in the form of footnotes, leaving the text free from interruptions All analyses must be carried out only after microscopic examination, which serves as a qualitative examination this is most important, as the method used for the estimation of the sesquioxides TiO_2 and MnO depends on the quantity of the oxide present The concluding section deals with rock analyses in general in which the author discusses the characters of good and bad analyses finally he includes a description of the calculation of an analysis into Niggli values

Vestiges of Pre Metric Weights and Measures persisting in Metric System Europe, 1926–1927 By Prof Arthur E Kennelly Pp xiii + 189 (New York The Macmillan Co , 1928) 2 50 dollars

As the metric system of weights and measures has now been exclusively adopted by nearly every European country, it is of some interest in connexion with proposals for its adoption by other countries to ascertain if possible to what extent its imposition upon the various peoples has hitherto proved effective The most obvious means of obtaining information on this matter would appear to be the study of the periodical reports and other publications of the respective Weights and Measures Departments Disdaining, no doubt, such arm chair methods, Prof Kennelly set himself the task of collecting evidence as to the persistence of pre metric vestiges by personal observation and inquiry in all the principal countries concerned This he accomplished under the auspices of the Bureau of International Research, during a sabbatical leave of absence granted him by Harvard University from July 1926 until September 1927

That the arduous but well ordered programme of the author was carried out with scientific zeal and discrimination is abundantly apparent , that official statements are often susceptible to enlightening amplification from other sources is demonstrated by a comparison of some of the letters received from officials and laymen, respectively, in the same locality But the net result arrived at, namely, that where pre metric terms persist they have practically always been ' metricised ' or ' submetricised ' in actual use, does not differ remarkably from the probable conclusions of any person whose pursuits entail frequent contact with administrative publications on weights and measures Nevertheless, this is a valuable work of reference with regard to the old units, their names, equivalents, and distribution W H M

Autolycus or the Future for Miscreant Youth By Dr R G Gordon (To day and To morrow Series) Pp 94 (London Kegan Paul and Co , Ltd New York E P Dutton and Co , 1928) 2*s* 6*d* net

ANYONE who has acquainted himself with Dr R G Gordon's larger works on " Personality " and " The Neurotic Personality ' will acknowledge the *a priori* likelihood of his writing a useful and authoritative pamphlet on juvenile delinquency, including the way in which society itself does much to produce its quota of pickers up of unconsidered trifles He quotes Samuel Butler to the effect that in Erewhon " a man who catches a disorder is punished whereas a thief or a rick burner is sent to a hospital , and the burden of his argument is that Butler s paradox is not so violent as it seems at first sight We punish the child who marks the wall paper instead of giving him materials for the proper exercise of his artistic prowess we punish the boy who plays football in the street, instead of providing him with a playing field and we assume that a girl who has been rescued from a life of infamy is best dealt with by being pitch forked into domestic service or into a public laundry Dr Gordon gives a simple and eminently readable account of the social educational psychological and medical factors involved in the treatment of miscreant youth and he makes a case for the calmly scientific instead of the emotional and half revengeful methods which at present hold the field

The Frog an Introduction to Anatomy Histology, and Embryology By the late Prof A Milnes Marshall Edited by H G Newth (Macmillan s Manuals for Students) Twelfth edition Pp x + 182 (London Macmillan and Co Ltd , 1928) 6*s*

MR NEWTH has left this work which had not been revised since 1912, in its well known form, but has made a number of useful alterations He has introduced into the section on technique notes on the use of methylene blue, eosin, and formalin, and has improved the instructions on section cutting The suggestion that the female frog should be dissected in saline solution to prevent the great swelling of the contents of the oviducts, the instructions for making and staining a blood smear, and for the preparation of the frog's bladder to show unstriped muscle, are helpful, and the dorsal dissection of the abdominal region of the frog, for which brief directions are given affords the student a view of the relations of certain blood vessels and organs from another aspect, and is useful as a revision exercise The description of the section of the retina, of the fertilisation and early development of the frog's egg, and of mitosis and meiosis, have been amended, but here and there the editor has carried over from the old edition words not consistent with his present description , for example, the use of the term ' egg ' on p 116 The terms epiblast, etc , might now be replaced by ectoderm, etc On p 55 the brief note on the second row of tarsal bones has been omitted

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications*]

Palæolithic Man in Ireland

No one ever questioned the possibility that traces of palæolithic man might one day be found in Ireland, in spite of the negative results of excavations, chiefly in caves, carried out over many years by the Royal Irish Academy and the Royal Dublin Society From time to time individuals have announced their discovery of palæolithic implements, but in every case such reports were open to the gravest scientific objection It is therefore with very special pleasure that we welcome the news contained in the accompanying statement, that the discovery has at last been made

The work which has thus been crowned with success was carried out last August, by a party of the Bristol Spelæological Society, under the leadership of Mr E K Tratman It was financed by the Royal Irish Academy, and some members of that body made the local arrangements and collaborated in the excavation , but the credit of the discovery is due to Mr Tratman and his colleagues

A short time ago we found ourselves constrained to adopt a position adverse to a discovery of alleged palæolithic implements on the west coast of Ireland We have never seen any reason to change our views on this matter everything that has been written about it, and every visit which we have paid to the site, have only confirmed us in our opinion Every possible explanation has been sought for our attitude, except the simple and obvious one that we did not, and do not, consider the 'discovery' in question to be more worthy of scientific acceptance than any of its not infrequent predecessors of the same type We have been accused of upholding preconceived prejudices in the face of evidence We have been accused of the yet more unworthy motives of personal or national jealousy We are therefore the more happy in being able to express our complete acceptance of the discovery here announced, and our full appreciation of its importance

J KAYE CHARLESWORTH
A W STELFOX
R A S MACALISTER
R LLOYD PRAEGER

EXCAVATIONS AT KILGREANY CAVE, NEAR DUNGARVAN, CO WATERFORD, 1928

IN the summer of 1928 excavations were carried out at this cave under the auspices of a joint committee, consisting of members of the Royal Irish Academy and the Spelæological Society of the University of Bristol The work was carried out personally by the members of the committee, assisted by students from Trinity College, Dublin, and the University of Bristol

The excavations gave the following stratification, outside the present cave mouth

1 Quarry debris from the roof of the former outer chamber of the cave, 0 2 ft

2 Hearth number 1, of late Bronze to early Iron Age date, 2 4 ft

3 A layer of brown earth and stones, with but few finds

4 Hearth number 2 Part of a polished stone axe came from this, suggesting a very late Neolithic to early Bronze Age date A number of human skeletons, very fragmentary, came from this level, 4 ft 4 ft 6 in

5 A stalagmite floor, divided into an upper tufaceous portion and a lower crystalline part These were separated by a third hearth The crystalline stalagmite was barren of remains, 4 ft 6 in 9 ft

6 A layer of loosely piled stones of unknown depth, but reaching to a depth of 12 ft from the original surface No remains from this layer

The surface of layer 5 was intact, all over the area in which it was exposed Before the task of excavating it was begun, special care was taken to ensure that all the upper deposits had been removed

Leaning against a projecting piece of the wall of the cave, and originally held in position there by a pile of stones (which had become completely embedded in the stalagmite as this material accumulated), was a human skeleton in a semi crouched position, with the left side against the cave wall As the limbs of the skeleton were traced down, through the stalagmite, to the level of the third hearth, and as there was absolutely no evidence of there ever having been any disturbance of the stalagmite by a burial inserted from above, it is obvious that the skeleton represents a deliberate burial from the level of the third hearth , a fact of first class importance from the archæological and anthropological points of view and one also that has important bearing on some of the geological problems of the late Pleistocene period

The fauna yielded by the tufaceous part of the stalagmite was as follows wild boar, Irish giant deer (or 'Irish elk'), reindeer, brown bear, wolf, fox, cat, stoat, hare, field mouse, Arctic lemming, birds, and land mollusca This is a very typical Late Pleistocene fauna

The presence of the skeleton, and the third hearth actually at the base of the deposit yielding this fauna, is conclusive proof of the presence of man in the south of Ireland in Late Pleistocene times It is unfortunate that as yet no implements have been recovered, so that we cannot yet place this Late Pleistocene man in his correct division of the Upper Palæolithic cultures

A full illustrated account of this discovery will be published in the next issue of the *Proceedings* of the Bristol Spelæological Society, now in course of preparation E K TRATMAN

Selection Rules in the Raman Effect

RECENT experimental work by McLennan (NATURE, Feb 2, 1929) on liquids and by myself (*Proc Nat Acad Sci* March 1929) on gases has shown definitely that transitions between vibrational levels of a non polar molecule such as nitrogen, oxygen, or hydrogen take place in the Raman effect I have pointed out that this, far from being inconsistent with the well known selection rules, is exactly what we should expect to happen from the quantum mechanical theory of dispersion

The selection rule which works in the Raman effect can be stated as follows in order that a shift corresponding to the transition $i \rightarrow k$ may be observed, it is necessary that *both* states i and k combine at least with a third state l, the Raman scattering becoming particularly intense when the energy $h\nu$ of the impinging quantum is near to $E_l - E_i$ If $E_l - E_i = h\nu$, we have fluorescence instead of a Raman effect

The latest results I have obtained on gases, with an improved apparatus, seem to fit very well with this theoretical scheme I will give here a brief account of them

I have extended the investigation in the ultra violet, using the line λ2536 of mercury, since the intensity of

the scattered radiation increases very rapidly with the frequency of the exciting light. This proved very successful, the intensity of the Raman lines scattered in gases being sufficient to record them in a large quartz Hilger spectrograph with a 60 hours' exposure. In this way a considerable improvement in resolution has been achieved as compared with the apparatus previously used for the visible region. An iron arc spectrum has been used as a standard, and under favourable conditions Raman lines have been measured with an accuracy of a frequency unit or better. The dispersion in the $\lambda 2536$ region was 131 frequency units per millimetre.

The most interesting feature of Raman spectra excited under these conditions in oxygen and nitrogen is the appearance on both sides of the line $\lambda 2536$ of a number of equally spaced lines, evidently due to rotational transitions. Four or five of them can be measured fairly well.

Now let us see what we should expect the rotational Raman spectrum of such a molecule to be like. Consider first the case of oxygen. Here the electronic bands to which the existence of rotational (and vibrational) Raman transitions is due (in the meaning that the upper levels of these electronic transitions play the rôle of the l state of the above stated selection rule) are essentially the bands of the Schumann Runge system, a ${}^3S \longrightarrow {}^3S$ transition. These consist only of a P and an R form branch, the lower (normal) electronic state possessing only odd, and the upper only even rotational states. Now consider a molecule in the lowest electronic state, and in the mth rotational state ($m = 1, 3, 5 \ldots$). This state combines only with the $m-1$ and $m+1$ rotational states of the upper electronic level. The first of these combines with the m and the $m-2$ rotational states of the normal electronic level, the second with the m and $m+2$. So, on the whole, the possible Raman transitions from the m rotational states to other rotational states are $m \longrightarrow m-2$, $m \longrightarrow m$, $m \longrightarrow m+2$. The second of them involves no change in energy—that is, gives scattered light of unmodified frequency. Of the other two, we need only consider what happens in the transitions involving a degradation in frequency ($m \longrightarrow m+2$), the others, of course, giving only anti Stokes's lines symmetrical with respect to the exciting line.

At room temperature, the Boltzmann distribution gives an appreciable amount of molecules for values of m up to ten or fifteen.

Now, we have, for the rotational energy

$$E_m = \frac{h^2}{8\pi^2 I_0}(m+1)m,$$

so that the Raman shift (in wave numbers) is

$$\Delta\nu = (E_{m+2} - E_m)/hc = (4m+6)h/8\pi^2 c I_0.$$

We should have a pattern of equally spaced lines, the spacing being 8 times the constant $h/8\pi^2 c I_0$. Only the first line should be spaced 10 times this constant from the exciting line.

The spacing in oxygen is too small to verify this last point, as the first three or four lines on each side overlap with the over exposed image of the $\lambda 2536$ line. But it was possible to measure fairly accurately the spacing of the lines. This gave the result $\Delta\nu = 12.0 \pm 0.5$ cm.$^{-1}$ Ossenbruggen finds the value $\Delta\nu = 11.5$ cm.$^{-1}$, thus agreeing within the limits of experimental error (W. Ossenbrüggen, *Zeit. f. Phys.*, **49**, 167, 1928; R. S. Mulliken, *Phys. Rev.*, **32**, 186, 1928). The triplet separation of the normal state in oxygen (R. S. Mulliken, *Phys. Rev.*, **32**, 880, 1928) is much smaller (2 cm.$^{-1}$), and we do not need to take it into account.

With nitrogen I have obtained a much better plate, on which the rotational components could be measured within a few tenths of a frequency unit. I give in the following table the measured frequencies, the meaning of the calculated values being explained later.

Obs.	Transition	Calc.	Difference
39504.4	$12 \longrightarrow 10$	39504.6	−0.2
39489.1	$10 \longrightarrow 8$	39488.6	+0.5
39472.5	$8 \longrightarrow 6$	39472.6	−0.1
39456.6	$6 \longrightarrow 4$	39456.6	0
39412.6	Exciting line	39412.6	
39352.6	$6 \longrightarrow 8$	39352.6	0
39336.6	$8 \longrightarrow 10$	39336.6	0
39320.5	$10 \longrightarrow 12$	39320.5	−0.1
39304.4	$12 \longrightarrow 14$	39304.4	−0.2
39288.4	$14 \longrightarrow 16$	39288.4	−0.2

Here the spacing of the lines is 16.0 ± 0.1 cm.$^{-1}$ If we assume that alternate rotational levels are missing, and that the electronic bands effective in the phenomenon—in this case the so called $X \longrightarrow a$ ${}^1S \longrightarrow {}^1P$ bands (H. Sponer, *Proc. Nat. Acad. Sci.*, **13**, 100, 1927) consist only of a P and R branch, we deduce for N_2 in the normal state $h/8\pi^2 c I_0 = 2.00 \pm 0.01$ cm.$^{-1}$, which gives for the moment of inertia

$$I_0 = 13.8 \pm 0.1 \times 10^{-40} \text{ gm. cm.}^2$$

We have, so far as I know, no data on which to check this result, but the value seems reasonable. If we had not assumed alternate levels to be missing, we should have found half this value, which is evidently too small.

The measurements in this case are accurate enough to extrapolate the position of the first rotational line. The calculated values in the table are obtained from the formula

$$\Delta\nu = 2.00\,(4m+6), \qquad m = 0, 2, 4, \ldots$$

using for m only *even* integral numbers. As satisfactory an agreement as this could not be obtained with a slight change in the constant 2.00 and the use of odd values for m.

So, on the whole, this seems to give support to the hypothesis that in the normal state of N_2 only even rotational states are present, or, at least, they have a higher statistical weight than the odd ones. An investigation of the structure of the $X \longrightarrow a$ ultraviolet bands of N_2 would show whether these deductions are correct.

Now, I think we can explain the, at first, rather puzzling fact, that the Raman lines corresponding to vibrational transitions in N_2 and O_2 (respectively 2331 cm.$^{-1}$ and 1554 cm.$^{-1}$) show no rotational structure, but, even with the higher dispersion of the quartz spectrograph, appear as single lines. We have, of course, all the allowed rotational transitions ($m \longrightarrow m+2$, $m \longrightarrow m$, $m \longrightarrow m-2$, for example, in O_2), but we must consider that each of those involving a change in m gives a *different* line; instead, when m is unchanged, the position of the line is nearly independent of m, because of the *very small* change in the constant $h/8\pi^2 I$ between the zero and the first vibrational state. So the line given by *all* the transitions $m \longrightarrow m$ has a very high statistical weight, and is practically the only one observed.

I have obtained, also, the Raman spectrum of gaseous hydrogen. It gives two lines excited by $\lambda 2536$, shifted by 583 cm.$^{-1}$ and 4159 cm.$^{-1}$ respectively. These have already been found in liquid hydrogen and explained by McLennan.

I will make a last remark concerning the Raman spectrum of carbon dioxide. In a recent letter to NATURE (Feb. 9, 1929) I pointed out that the frequency observed in the Raman effect, $\nu = 1284$ cm.$^{-1}$,

is practically coincident with the difference between two frequencies observed in infra red absorption Now, I notice that Eucken (*Zeit f Phys*, **37**, 714, 1927), in his theory of the straight line model of the carbon dioxide molecule, assumes the existence of an 'inactive' frequency, $\nu = 1274$ cm $^{-1}$, and the validity of the above mentioned relation, at least to a first approximation Thus the data on the Raman effect give strong support to Eucken s model of the carbon dioxide molecule F RASETTI

California Institute of Technology,
Pasadena, California,
Mar 15

Floating Mercury on Water

IN a letter in NATURE of Mar 16, Mr N K Adam describes the floating of small globules of mercury on a water surface, even when the latter was considerably contaminated He concludes that for equilibrium to be possible, the mercury air tension must have been reduced by the order of one or two hundred dynes It is not necessary to suppose such a decrease It appears that the part played by curvature of the surfaces in determining conditions for the equilibrium or the spreading of one liquid on another has been neglected Experimentally, we have the observations of Burdon (*Proc Roy Soc*, **38**, 2, 154 1926), who found that water would spread over the surface of a large, clean mercury drop, but that its progress was stopped when the curved edge of the drop was reached where acceleration 'downhill' would be expected

The familiar criterion for spreading is derived sometimes from the consideration of the three 'tensions' involved and the possibility of constructing a Neumann triangle, but more often from the point of view of surface energy Spreading will occur if the advance of the liquid brings about a decrease in the total surface energy Let T_1, T_2, T_{12} be the tensions involved, and let the increase in area when the liquid 1 advances a small distance A to B be S (Fig 1*a*) The increase in energy is then $T_1 S + T_{12} S$ and the decrease is $T_2 S$ Then for spreading, $T_2 S > T_1 S + T_{12} S$ or

$$T_2 > T_1 + T_{12} \tag{1}$$

But suppose now that the surface of the lower liquid 2 is curved, as in Fig 1*b* Here the decrease in energy

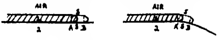

FIG 1

is still $T_2 S$, but the increase is now $T_1 S' + T_{12} S$ —where S', the increase in area of the liquid air surface of 1 is *not necessarily equal to* S Then the condition for spreading becomes

$$T_2 > T_{12} + T_1 \frac{S'}{S} \tag{2}$$

If S' is greater than S, it is quite possible that even if condition (1) is fulfilled, that is, spreading occurs on a plane surface, (2) is not, spreading is stopped by the curvature

Using the figures given by Mr N K Adam for the uncontaminated liquids, spreading would be stopped if the ratio S'/S were greater than 1 4 1, so that spreading may have been stopped by the curvature (0 5 mm. diameter) without the considerable lowering of the tension stated

Yet for the curved surface as for the plane, the condition that the Neumann triangle cannot be drawn is still (1), and from the point of view of the equilibrium of tangential forces at the interfaces, it is difficult to see how curvature can enter into the problem It seems to me that this is another indication of the many that the conception of three tangential forces at a point—and of Neumann s triangle—is wholly inadequate to represent the forces involved in capillary phenomena

It may be noted that in Coghill s work on lenses of oil floating in water (*Tech Paper* 262, Bureau of Mines, Washington 1923) the measured interfacial angles did not agree with those calculated from the Neumann triangle

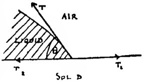

FIG 2

It must have been often remarked that in the case of a liquid in contact with a solid for example, the three tensions alone are to any student of elementary mechanics not in equilibrium though few text books mention that other forces have been omitted or explain what these forces are If the 'tensions' do not give an adequate representation here, why can we assume that they are sufficient in other problems? Theoretically unsound, the Neumann triangle has no experimental usefulness—and the spreading coefficient used by Hardy and Harkins is limited in its application to plane surfaces

(A C BURTON

University of Toronto
April 5

IN a letter appearing in NATURE for Mar 16, Mr N K Adam describes floating mercury droplets These droplets are minute (0 5 mm in diameter), and Mr Adam evidently regards them as fluid throughout supported by the surface tension of the water

In a letter to NATURE for July 2 1903, p 199, I described the production of mercury bubbles floating on water These might be any size up to 2 cm in diameter and were supported not by surface tension but by flotation, as might be seen from the fact that they floated even when the water film was continuous over them Measurements of the weights of mercury forming those bubbles and estimations of the thicknesses of their skins were given

HENRY H DIXON

School of Botany,
Trinity College, Dublin, Mar 17

Hibernation of *Lucilia sericata*, Mg

SINCE the hibernation of the Muscidæ affords such general interest, it is felt that recent observations on this phenomenon as exhibited in the particular species *Lucilia sericata*—the most important entomological pest of sheep in North Wales—are worthy of note

It should be explained that my interest in the hibernation of *Lucilia sericata* arose as a result of a survey of Maggot Flies attacking sheep in North Wales in 1928, which showed that *sericata* was the only species concerned

All larvæ used during these observations were taken by farmers direct from infested sheep When received, at almost daily intervals throughout the season, they were placed in the insectary in cages containing a piece of fresh meat on soil From May 5 until Sept 8, the period which elapsed between the receipt of the larvæ at the laboratory and the date of emergence was fairly constant—on the average 21 days The majority of the larvæ received on Sept 8 and 10, however, had not pupated by Oct 10 Instead, many remained quiescent in the soil at the bottom of the cages, while

others had entered empty pupa cases Further, it was noted that not a single larva of the ten subsequent batches—the final batch being received on Oct 27—had pupated

On Oct 15, 720 such larvæ received from various sources, were available for hibernation observations and were used in the following experiments Six earthenware pots, 5 inches deep, were filled with soil and closed above with muslin four represented arable conditions, while two had turf placed on top of the soil to create a grassland environment One of the grass land pots and two of the 'arable' pots were placed in the laboratory, while the duplicates were sunk in the soil out of doors, the rims of the pots being at ground level 120 larvæ were allowed to drop on to the sur face in each of the pots all had burrowed out of sight in about 15 minutes A week later larvæ were found at the bottom of each pot

Periodic examination of the out of door pots showed that the larvæ remained thus buried and in a quiescent state throughout the winter, the mean daily tempera tures (taken just above the pots) for the months con cerned being Oct, 59 85° F Nov, 51 09° F Dec, 43 58° F, Jan, 41 77° F Feb, 43 76° F Mar 52 98° F April, 57 3° F

On Feb 14, with a minimum temperature of 16° F, the soil was completely frozen, yet the quiescent larvæ when disturbed proved to be viable No activity was observed in the pots until the period Mar 20–26 (mean daily temperature, 53 86° F) when it was noticed that the larvæ were making their way towards the surface They eventually came to rest at a level approximately ½ in below the surface On April 2 the first pupa was found, and by April 10 the majority of the larvæ had pupated The first fly emerged out of doors on April 27

Observations on the indoor series gave similar data except that the flies emerged at an earlier date the first being found on April 10 The mean temperature throughout the winter was more or less constant at 51° F (since the last week in March it has risen about 9°) The humidity was maintained by daily watering of the pots

The hibernation of *Lucilia sericata* has not so far as I am aware, formed the special study of a previous worker Mention is made in some works of the difficulty experienced in getting the larvæ to pupate in the autumn, but there is no suggestion that the insect overwinters in the larval stage Records from S Africa and New South Wales show that adults have been trapped throughout the year while in the United States research has indicated that *sericata* overwinters in the larval and pupal stages

From the observations here mentioned it would appear that the normal mode of hibernation of *Lucilia sericata* in North Wales is in the larval stage Further while the return of the larvæ to the surface after overwintering and prior to pupation obviously facilitates emergence, it should be pointed out that at this time they are more open to control methods than at any other stage after leaving their host

W MALDWYN DAVIES,
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University College of North Wales,
Bangor

Cosmic Radiation and Radioactive Disintegration

DR L R MAXWELL, in NATURE of Dec 29, 1928, gives an account of experiments intended to show the influence of cosmic rays on the speed of radioactive disintegration of polonium According to Perrin, the radiation may be regarded as a possible cause of radioactive changes The detailed study of cosmic rays, carried out lately by numerous investigators, and the determination of their probable wave lengths, combined with the ideas of Perrin, involun tarily led us to think that the cosmic rays may be the real cause of radioactive processes The frequency of cosmic rays is of such magnitude that their quanta ought to be sufficient to disintegrate the nucleus

At our request, Mr E Halfin, in June of 1926, per formed some experiments with radon analogous to those of Dr Maxwell The activity of two nearly equal quantities of radon was carefully measured, and thus the exact value for the ratio of the activities of two chosen samples was obtained Immediately after, one sample was let down to the bottom of the Gulf of Finland to a depth of about 20 feet and the other sample was left in the laboratory After several days the first sample was taken out and the comparison of the activities of two samples was repeated in the laboratory These experiments have shown that, within the limits of possible errors, the speed of disintegration of the sample of radon which was kept under the water did not appreciably change The error of the corresponding measurements in any case did not exceed 1 per cent Our experiments with radon and Dr Maxwell's experiments with polonium show that the cosmic rays do not affect in appreciable degree the speed of disintegration of either radon or polonium These facts lead us to the conclusion that the disintegration of the two elements investigated is not at least entirely, due to the action of cosmic rays

It would not be correct though on this ground, to deny any influence of the rays on radioactive pro cesses As a matter of fact, the total intensity of the cosmic radiation is so small that it is quite possible that it affects in some way a very minute number of radioactive atoms and its action cannot be detected especially in the cases of radioactive atoms of short life

The cosmic rays, furthermore, may perhaps give a start to the disintegration process in the radioactive family and actually cause the disintegration of the first element in the family, for example, uranium Experiments with this element (observation of the growth of activity of uranium X_1) might throw some light on the last question In this case the total intensity of cosmic rays might be sufficient to account for the radioactive process, as the number of atoms of uranium which disintegrate in unit time is very small

N DOBRONRAVOV
P LUKIRSKY
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Leningrad

The Structure of the CH_4 Molecule

IN a recent investigation of the ionisation processes in methane, Hogness and Kvalnes (*Phys Rev*, 32, December 1928), using a mass spectrograph method find that at 14 5 volts only CH_4^+ ions are formed, but at 15 5 volts two processes occur, either stable CH_4^+ ions are formed or unstable CH_4^+ ions which dis sociate spontaneously into CH_3^+ ions and neutral hydrogen atoms, the probabilities of the processes occurring being approximately equal over a wide range of pressure

Two models have been proposed for the CH_4 molecule, one having a C^4 central ion of neon like character, the other having a C^{4+} central ion, but neither of these models will explain the results quoted above If the four chemical bonds in methane con sist of pairs of shared electrons, each pair being formed by an L electron of the carbon atom and a hydrogen

electron, then a simple explanation can be given, for since there are two 2_1 and two 2_2 electrons in the carbon atom, two of the bonds will differ from the other two, that is, two of the pairs of electrons will be differently bound from the other two Two ionisation potentials would therefore be expected having approximately equal probabilities of excitation This assumes that the ionisation potential of either of the two electrons forming a bond is the same That two of the bonds in methane differ from the other two is in agreement with Mrs Lonsdale's view that the carbon atom has two different kinds of valencies (*Phil Mag*, **6**, p 433, 1928), and is also supported to some extent by the observation of Cabannes and Gauzit (*Jour de Phys*, **6**, p 182, 1925), that methane has a small depolarisation factor, an indication of small optical anisotropy Experimental evidence also tends to show that models of the methane molecule having either a C^{4-} or a C^{4+} central ion are incorrect (cf T H Havelock, *Phil Mag*, **3**, p 444, 1927, **4**, p 721, 1927)

G W BRINDLEY

Physical Laboratories,
University of Leeds,
April 26

The Constitution of Oxygen

DR F W ASTON has remarked (NATURE, **123**, 488, Mar 30, 1929) that he finds no positive ray evidence for the existence of isotopes of oxygen, and he states that if O^{18} exists, as concluded by Giauque and Johnston (NATURE, **123**, 318 Mar 2, 1929), it must be in a proportion less than 1/1000 of O^{16}

Giauque and Johnston based their result on data published by Dr Dieke and myself (*Proc Nat Acad Sci*, **13**, 670, 1927) Further evidence bearing on the question has now been found, confirming the existence of O^{18}, and also the limiting proportion set by Aston From spectrograms made with low solar altitude it has been possible to augment the A' band of oxygen from 26 lines, as formerly described, to 73 lines About one half of these belong to the alternate system of doublets which are to be expected from the unsymmetrical molecule O^{16}–O^{18}, while the rest of the new lines are extensions of the previously recognised system of doublets The observed positions of the lines of this band agree with those calculated for the isotopic molecule, and the new data thus decisively confirm the existence of O^{18}

Intensities of the isotopic band lines have been compared with those of homologous lines in the A band by so choosing the lengths of air path as to make the two bands appear alike when registered with the same spectrograph From the ratio of the air paths it was found that the A band is 1250 times as intense as the A' band, and, approximately at least, this represents the relative abundance of the molecules O^{16}–O^{16} and O^{16}–O^{18} More complete discussion will be found in a forthcoming paper in the *Proceedings of the National Academy of Sciences*

HAROLD D BABCOCK

Mount Wilson Observatory,
Pasadena, California,
April 15

Selective Absorption by Excited Mercury Vapour

OUR attention has been directed to a paper by M. M Ponte on the selective absorption by excited mercury vapour (*Comptes rendus*, **187**, 37 39, July 2, 1928) giving results of photometric measurements on the prominent lines in the arc spectrum of mercury M Ponte refers to a paper by us on the same subject (*Proc Roy Soc*, A, **100**, p 149, 1921), but does not notice a paper by Turner and Compton (*Phys Rev*, **25**, 606 612, 1925) He finds that the absorption diminishes as the current term number of the line in a series exhibiting absorption increases, a similar result has been recorded by Turner and Compton (loc cit)

In the latter part of his paper, M Ponte records his observation of the reversal of the green line and six of its satellites and of 4358, but not of the two yellow lines In this connexion we have to point out that in a paper published by us in 1924 (*Proc Roy Soc*, A, **105**, 520 531), not referred to M Ponte, we have described, among others, experiments proving the reversal of the green line and all its satellites except one, namely, − 0 237, of the line 4358 and four of its satellites, of the two yellow lines, and two of the satellites of 5769, namely, + 0 044 and − 0 050 The device of using the broadened lines from a high pressure source as a background for the formation of the reversal lines produced by an absorbing column at low pressure suggested by M Ponte has been mentioned by us in the same paper M Ponte's method of exciting the absorbing column by maintained high frequency oscillations is of special interest

E P METCALFE
B VENKATESACHAR

Central College
University of Mysore,
Bangalore, India, April 3

Raman Effect in Atomic Hydrogen

IN the paper on the dispersion of hydrogen like atoms published in the *Proc Nat Acad of Sci*, **14**, 253 (1928), I have obtained a solution of the Schrodinger wave equation, for a hydrogen atom in the field of radiation of frequency ν, of the form

$$\psi = e^{2\pi i E t/h}[\psi_0 + e^{2\pi i\nu t}u_1 - e^{-2\pi i\nu t}u_2],$$

where ψ_0 is the solution of the unperturbed equation, while u_1 and u_2 are small quantities which are functions of co ordinates only

The Raman effect for atomic hydrogen comes out of this solution naturally If one calculates the matrix elements corresponding to components of the electric dipole moment, one obtains terms containing factors $\exp\ 2\pi i(\nu - \nu_1)t$, $\exp\ 2\pi i(\nu + \nu_1)t$, and $\exp\ 2\pi i\nu_1 t$ respectively, where ν_1 is the frequency of absorption lines In addition to the ordinary transitions, the transitions with a change of azimuthal quantum number by ± 2 are now permitted Details of the investigation will be published elsewhere

BORIS PODOLSKY,
(National Research Fellow)

University of California,
Berkeley, California,
April 15

Ozone Absorption during Long Arctic Night.

A LETTER from Prof R W Wood on this problem (NATURE, April 27, p 644) calls for some comment Prof Wood's contention that my observations of ozone absorption in December last (cf NATURE, Feb. 9, p 207) are not decisive because the atmosphere above my station was sunlit at noon, overlooks the important fact that *this sunlight had all been filtered through the atmosphere, and at grazing incidence, such as to have its activating constituents effectively removed* On account of the crude equipment the results are, however, provisional in nature, and this and allied problems will therefore be pursued next winter with an improved telescope

S ROSSELAND

University Observatory,
Oslo, April 29

Iron Manufacture and Heat Generation[1]

By Prof HENRY LOUIS

THE date and even the place of the first use of iron by mankind have never been determined, it appears to be generally held that iron was first produced in workable quantity on the southern flanks of the Caucasus, and the date assigned is usually somewhere about 3000 B C, though for my purpose both the place and the exact or even the approximate date are matters of secondary importance My main object is to indicate that the history of iron manufacture shows it in the light of a consequence of the ever-increasing power which mankind gradually learnt to exercise over the production of heat, and I hope to be able to show that the history of iron and the history of heat generation have gone hand in hand throughout the ages, and that the former has been absolutely dependent upon the latter It is certain that, before iron came into use, the metallurgy of bronze was already highly developed Articles of bronze of the Later Bronze Age show that the art of bronze founding had already reached a high stage of perfection The art of making cored castings was undoubtedly known, and it seems probable that even the *cire perdue* process had been invented

No doubt the simple reduction of metallic iron from its ores would have been well within the capabilities of these primitive metallurgists, but from the simple reduction of the metal to its fashioning into any useful form is quite a far step Oxide of iron is reducible to the metallic state at a very low temperature, not exceeding 500° C, but the iron so produced is more or less pulverulent and useless for all practical purposes To weld it into

FIG. 1 —Blowing up the fire by the mouth blowpipe (Egypt). From Wilkinson's 'The Ancient Egyptians'

a coherent mass capable of useful application requires not only a considerably higher temperature, but also for articles of any size a considerable body of heat, and this would apply equally to the forging of meteoric iron The only information that we have as to the early means of producing the necessary heat is derived from Egyptian mural paintings All the earlier ones—for example, one from the frescoes of Beni Hassan (Fig 1), said to date from about

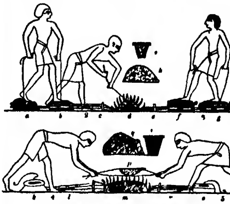

FIG 2 —The earliest known form of bellows (Egypt) From Wilkinson's "The Ancient Egyptians

a b, k, o the leather case
c, e, l n the pipes conveying the wind to the fire
d, m the fire
h, q, charcoal
k and *o* are raised as if full of air

2500 B C —show men blowing up a fire beneath a crucible by means of mouth blowpipes made of reed and tipped with clay, and it is evident that with such rudimentary appliances only very small pieces of iron could be produced

The first known representation of any mechanical means for producing a blast is from the walls of a tomb of the period of Thothmes III, supposed to be from about 1500 B C This primitive bellows (Fig 2) apparently consists of a flat pot covered with skin, in the centre of which is cut a hole that can be closed at will by the heel of the operator, which thus forms a valve, the skin, when released by the heel, being pulled up by a cord in the worker's hand It is interesting to note that this identical type of bellows is still used in India by certain tribes for the purpose of iron manufacture, the only improvement in more than 3000 years being the use of a couple of light bamboos which act as springs to pull up the hide cover A photograph of a native lad working these bellows (Fig 3), taken a few years ago by the late Mr Seymour Wood, shows the method, moreover, these bellows have been figured in full detail by Dr John Percy in his classical work on the "Metallurgy of Iron and Steel"

The position at a tolerably reliable date can be well estimated from the British Museum excavations at Djerabis on the Euphrates (the Charchemish of Biblical times), as recorded in Biblical writings, this place was attacked and captured by Nabuchadnoser, King of the Babylonians, in 604 B C The finds consisted of broken swords and spear-heads, all of bronze, and of numerous arrow-heads, both of bronze and of iron; there was also found a beautifully finished bronze mould

[1] From the presidential address delivered to the Iron and Steel Institute on May 2.

for casting the bronze arrow heads, and it is particularly noteworthy that these bronze arrow heads are far superior in execution and finish to the iron ones—the iron ones being all tanged, whilst most of the bronze arrow heads are socketed

It is therefore evident that at this date, even in the centre of the highest civilisation of the time, skill in working iron had not reached anything like so high a level as that of the bronze worker, the finds are, of course, not conclusive evidence that no larger weapons of iron were in use at the time, but I think that the conclusion may fairly be drawn that they must have been far scarcer than the bronze weapons, and that the difficulty of working even moderately large pieces of iron had by no means been fully overcome, and that whilst small articles of iron could be made readily enough, there must still have been difficulty in producing the larger articles which required a considerable body of heat This emphasises the essential point which I want to bring out, that the means of generating the requisite heat must have been the controlling condition in the manufacture of iron Furthermore, as is well known, whilst iron reduced at a low temperature, even from impure ores, is sufficiently pure not to be brittle, it must necessarily be very soft, and it may readily be supposed that a well made bronze sword was for quite a while superior to a soft iron one This difficulty must have persisted until a much later date in northern Europe, since the Norwegian sagas more than once record that a warrior had a sword so soft that he had to stop to straighten it underfoot in the course of the conflict

On the other hand, it is quite certain that in the countries bordering on the Mediterranean, where the knowledge of metallurgy was much older and civilisation was much further advanced, temperatures high enough to cause some carbon to combine with the iron and thus make relatively low carbon steel or steely iron had been attained at a very much earlier date, as is evident from the oft quoted passage in Homer's Odyssey, from this it is obvious that steel or steely iron capable of being hardened by quenching was known in Homer's time, though the carbon content could not have been excessive, seeing that the metal so treated was not too brittle to prevent its being used as an axe, yet there must have been enough carbon present to cause perceptible hardening by quenching, seeing that Homer states that such quenching gives strength to the iron On the other hand, Homer's frequently repeated epithet for iron "wrought with much toil" shows that the manufacture of iron was still in an elementary stage, it will be remembered that Homer certainly wrote before 800 B C

It could, however, not have been very long after the beginning of our era before, with the employment of larger furnaces and, therefore, the production of a greater body of heat, a true steel was produced, and this would, of course, be the case more readily when manganiferous ores happened to be employed instead of ordinary iron ores Thus both Horace and Ovid refer in their poems to the high quality of Noric iron The Noric kingdom corresponded to the region now known as Styria and Carinthia, and it is quite probable that this Noric iron was made from manganiferous spathic iron ores of the Styrian Erzberg of Eisenerz Jars, who visited the Erzberg in 1758, directs attention to the fact that steel was readily produced by smelting certain of these ores Similar ores appear also to have been worked in Spain, and they, too, must have produced steel or steely iron, and we have evidence that some at any rate of this material consisted of iron combined with sufficient carbon to be capable of being appreciably hardened by quenching It must be remembered that the above statements as to the use of iron refer only to the region which at that early date was the centre of human civilisation, it is generally held that iron was not introduced into Britain until 500 B C, and that its manufacture did not commence in these islands until about a century later

FIG 3—Bellows as used in India

Before Cæsar's invasion, iron was certainly being made in the south of England, though the Brigantes in the north appear still to have been in a Stone Age Before Cæsar's time, iron currency bars were in use in southern Britain—a fact which would seem to imply that, although iron was being made, it was still scarce and comparatively valuable The manufacture of iron continued in Britain throughout the Roman occupation The largest

mass of Roman iron found in Britain, if not in the world, is the mass discovered at Corstopitum, near Corbridge, in Northumberland, described by Sir Hugh Bell Its date is considered to be between A D 350 and 380, and its weight was about 3 cwt It is quite clear that the method of iron production throughout all this period was always the same—namely, direct reduction by charcoal in furnaces probably not more than 3 ft or 4 ft high, and blown by bellows worked by man power, in which the temperature was only high enough to produce soft malleable iron, or, at the best, with suitable ores a steely iron or a steel Apparently this method of iron making must have continued during the next thousand years or so, probably furnaces were steadily increasing in size, larger lumps of iron were being made, and probably steely iron or even steel was produced at will The art of letting down or tempering steel must also have been discovered, and the technique of iron working, as distinct from the extraction of iron, made immense strides

An invention that must have contributed no little to the increase in the size and power of the medieval furnace was that of mechanical blast production Agricola, whose well known work is dated 1556, figures and describes in much detail the construction of a bellows with valves of quite modern type, worked by a water wheel, and it is on record that such bellows were in use at Göllnicz in 1435 A natural result of the increase in the height and power of the furnace and of the attendant higher heats thus generated was the production of white cast iron, and it is tolerably clear from Agricola's writings that this was known in his day No doubt this unexpected result of the higher furnace temperature must have been a disagreeable surprise to the early metallurgist, who found in his furnace a lump of this hard, brittle, useless material instead of the mass of malleable iron or steel which he hoped to produce In the course of time, however, he would discover that this useless metal could have its pristine malleability restored to it, or, as he expressed it, the iron could be 'freshened' by heating it in another (or possibly the same) furnace When this technical stage had been reached, the iron-worker no doubt soon learnt to appreciate the advantage of a continuous process in which the metal could be made to flow out from his reduction furnace, over a discontinuous process in which the lump of metal had to be dragged out of the furnace either by tearing down the furnace front or by lifting the lump bodily out of it This step would lead to a still further increase in furnace and bellows capacity, and this in turn would bring about a further increase in furnace temperatures, with the again unexpected result of producing grey cast iron, as soon as the temperature became high enough to reduce sufficient silicon It would soon be found that such iron ran very fluid and was admirably adapted for making castings

Apparently one of the very earliest forms of iron castings was the iron stove plate, which originated in Germany The oldest known cast-iron stove plate is dated 1497 and was from the Eifel, which appears to have been one of the earliest centres at which castings of this kind were made No doubt it took the early founders some time before they learnt to adapt their bronze-founding technique to this new material, very much in the same way as in our own time iron-founders have had to learn to modify their methods for the successful production of steel castings, but the superior qualities of articles made of cast iron would be a sufficient incentive to urge these early workers to find out how to overcome their difficulties Once this was done, a demand for such pig iron would arise and the blast furnace making charcoal iron was evolved The next step was the substitution of coke for charcoal, thus attaining the production of still higher temperatures, it is, by the way, interesting to note that the first coke furnaces still used bellows worked by a water-wheel, just as in Agricola's time, and that these continued in use up to the middle of the eighteenth century About that date they were, however, replaced by iron blowing cylinders, capable of generating a more powerful blast, and therefore, of producing higher temperatures, whilst Neilson's invention of the hot blast in the year 1828 enabled still higher temperatures to be attained in the blast-furnace

The next stage was the production of mild steel in the Bessemer converter and the Siemens open hearth furnace, to be followed by the important modification of Thomas and Gilchrist, which we know as the basic process Necessarily, these processes involved the use of still higher temperatures than had hitherto been attained and finally we reach the production of alloy steels in the electric furnace with its capacity for generating still higher temperatures

I do not wish to imply that each one of these successive stages immediately and definitely put an end to all use of the earlier processes Quite the contrary is the case, for there are many examples of the old and new methods working side by side Even to day in India and in many other similar countries the direct process is still in use Again, although Abraham Darby successfully made pig iron with mineral fuel so far back as the year 1735, charcoal blast furnaces are still in operation in Sweden and various other parts of the world, and there was even one still at work in Great Britain at Backbarrow, near Ulverston, until Dec 17, 1925 In spite, however, of this overlapping of processes and of the survival of the older methods alongside of newer ones, the line of progress is quite unmistakably defined

It will, I hope, be admitted that this rapid review of the history of iron manufacture is correct, at any rate, in its main features, and that my contention that the power to produce high heats has throughout been the controlling factor, is well founded, I want to make it clear that I consider that the various stages of iron manufacture and of the generation of ever higher temperatures are not two independent concurrent parallel lines along which the development of human civilisation has

travelled, but that they are distinctly related as cause and effect This being true of the past, what can we say as to the future ? Just as there is a lower heat limit below which iron capable of being usefully applied in the arts could not be produced, so there must be an upper limit, and I suggest that this limit is reached when our furnaces are capable of generating a temperature sufficient to volatilise the iron, it seems fairly obvious that heats higher than this cannot well be usefully employed Such heats are, however, now readily attained in the electric furnace and it would therefore seem that from this point of view the limiting condition has already been reached by the metallurgist On the other hand, there seems but little inducement to increase the quantity of output, seeing that our potentialities of production appear to be now actually ahead of the world's requirements, and that there is every indication that even our present appliances will enable us to keep pace with any future demands

I emphatically do not mean to imply that we have reached finality in the metallurgy of iron, but I do hold that future progress will have to be along different lines Fortunately, we are already able to see what direction this progress must take Recent advances have all been in the direction of improvement in quality and in the attainment of properties in which ordinary iron by itself is deficient In other words, the future of the metallurgy of our metal will be directed, not by the crude methods of trial and error of the past but by the application of principles developed by the methods of scientific research For something like four centuries Great Britain has led the way in the great improvements in the iron industry along the old lines which I have been describing, we are however, also the inventors of the science of metallography and of alloy steel, we may therefore, fairly claim that even in modern scientific methods we are equally leading the world in the metallurgy of iron, and there is every reason to presume that the great work which members of the Iron and Steel Institute have done in the past in developing that iron industry which is the basis of our modern civilisation will still continue in the future although, as I have suggested, that work will be carried on by means of modern methods and be based upon entirely different principles

Progress of the Great Barrier Reef Expedition

By Dr C M Yonge, Balfour Student, University of Cambridge

IN the three months which have elapsed since the last report, the work of the Great Barrier Reef Expedition, in all its branches, has made excellent progress Naturally, the weather conditions have not been so favourable as they were in the winter, heavy rains and humid heat, with wet bulb readings so high as 86° F, have been experienced, but work has been interfered with far less than was anticipated The most serious drawback has been the state of the tides, the day low tides being very poor, which necessitated much collecting by night On the other hand, sea work has proceeded without a hitch in spite of the previous gloomy accounts of the storminess of the summer months

A great loss has been experienced in the departure from Low Island on Dec 12 of Mr and Mrs F S Russell and Mr G Tandy, who were compelled, owing to the termination of their leave of absence, to return to England Dr T A Stephenson has succeeded Mr Russell as second in command, while Mr A P Orr has taken over charge of the boat party, Mr J S Colman carrying on Mr Russell's work on zooplankton There is, unfortunately, no professional botanist to succeed Mr Tandy, though Miss Glynne is expected for two months later in the year, meanwhile Mrs Stephenson is doing what she can to continue the collection of algæ Mr. M Spender, of the geographical section, is now with us permanently, while Miss E A Fraser, of University College, London, and Dr S M Manton, of Cambridge, join us shortly Both will work in co operation with the reef party under Dr Stephenson

The regular plankton and hydrographic observations at the station 3 miles east of Low Island have been continued with scarcely an interruption, a further station has been worked in Trinity Opening, all from the *Luana*, while on two occasions the powerful motor launch *Merinda* has been hired from Cairns for work beyond the Barrier For the hauling in of nets and hydrographic gear from deep water a friction winch with a small motor has been purchased, and this renders work both easy and relatively speedy

At the inside station Mr Orr reports that temperature has risen steadily to 29° C at the surface and 28 8° C in deeper water, while salinity has fallen and continues to fall as a result of the heavy rains On several occasions there has been a definite gradient in temperature and salinity, accompanied by a fall in oxygen saturation in the deepest layers, though without any production of phosphate, but this has never lasted more than a week at a time or ever been considerable enough to withstand a wind of more than 20 miles per hour The hydrogen ion concentration has remained steady throughout Observations made at a depth of 600 metres beyond the Barrier showed that temperature was constant down to 50 metres, beyond which it fell rapidly to 10 9° C at 600 metres Below 50 metres, pH value and oxygen saturation sank and phosphate content rose On Linden Bank, a coral formation beyond the Barrier and covered with 34 metres of water, the conditions were very similar to those inside the Barrier The turbidity of the water is far less beyond than within the Barrier

Miss S M Marshall and Mr Colman are continuing routine work on the phytoplankton and zooplankton respectively As the lack of nutrient salts in the water indicates, there has been no

significant change in the numbers of the phyto plankton within the Barrier, while the numbers have been found even smaller in the open sea stations, there being little difference in type save for a few oceanic flagellates rarely found inside The only notable change observed in the zoo plankton occurred during the three weeks at the end of November and the beginning of December, when spatangid plutei appeared quite suddenly in vast numbers, the coarse silk townet catching just under 300,000 in a half hour haul It may be noted that dredging has revealed the presence of great numbers of a species of *Lovenia* in the mud around Low Island, one haul of the Agassiz trawl bringing in a catch estimated at about 20,000 Salps and Larvacea continue to fluctuate in an apparently irregular manner, and also copepods, which usually comprise numerically more than half the catch On one occasion when planulæ were being extruded from *Pocillopora* on Low

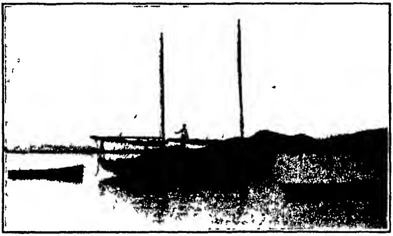

FIG 1 —The *Luana* at anchor between Snapper Island and the mainland

Island, some 3000 similar planulæ were caught in the coarse silk net Again, on another occasion the numbers of *Cavolinia* rose from an average of less than 50 to 1200

Work over the reef flat by members of the boat party has been continued Mr Orr made a de tailed study of a coral pool at spring tides, and found that, though there were very considerable changes in the hydrogen ion concentration, excess base, and temperature, there was no precipitation of calcium There was a very low night tide and the oxygen saturation fell to 18 per cent, rising during the day to 230 per cent In the mangrove swamp the oxygen content and pH value fell both by day and night during the low tides, instead of only during the day as in the coral region Miss Marshall finds that the numbers of the phyto-plankton in the anchorage remain low, such slight fluctuations as there are being without apparent cause The zooplankton collected by Mr Colman weekly has become progressively poorer in num bers and variety, though spatangid plutei and *Cavolinia* appeared at the same time as at the three-mile station

Other work by members of the boat party has included the exposure, by Mr Orr, of jars for the collection of sediment, in selected areas on the reef flat and in the lagoon These are collected weekly, and show clearly that the quantity of sediment is dependent on wind force and on the position of the jar, the sediment being mainly organic detritus mixed with some sand after stormy periods The results from the various jars have so far been quite consistent and lend no support to the theory that abundant sediment is inimical to coral growth Miss Marshall has done interesting work on the oxygen exchange of the planulæ of *Porites*, and found that, though their algæ produce a considerable amount of oxygen even at this stage, this does not balance the loss of oxygen due to respiration, also that more is pro duced in sunny than in dull weather

Dr T A Stephenson has completed a new type of experiment for observing the growth rate of corals By the aid of the diving helmet, a number of colonies have been marked in particular ways *in situ*, working in about 12 20 feet of water It may be suitably mentioned here that this helmet has proved of great value, parti cularly in connexion with Dr Stephenson's work, but also in the collection of Mr Orr's sediment jars and of corals for experi mental purposes Dr Stephen son has continued his routine observations on the gonads of *Favia* and *Symphyllia*, and has made further progress with the ecological survey Both *Pocillo- pora* and *Porites* have given off abundant crops of planulæ, num bers of these have been collected and reared, detailed observations being made as to the formation of young colonies from settled planulæ He has been engaged on manifold constructional activities on the reef flat, particularly in connexion with the rearing and collection of planulæ and the observation of the spawning of reef animals He has also made a new aquarium consisting of concrete tanks through which water runs continuously, this being parti cularly useful in connexion with Mrs Stephenson's work on the reproduction of reef animals, which has been continued on the lines previously re ported and also extended by the examination of various kinds of spawn collected on the reef

The work on animals of economic importance now occupies practically the entire time of Mr F W Moorhouse Although his farm of *Trochus* was unfortunately destroyed by stingrays, the previous six months had shown that the average increase in diameter of specimens ranging from 2 cm to 6 cm was no less than 2 mm per month, giving a yearly increase of about 2 5 cm Growth is continuous, and no disturbance rings are found on normal shells He has been able to confirm these figures by the measurement at each full

moon of some 600 animals taken at random, the measurements being graded into groups of 0 2 cm and the results recorded graphically He has now 360 sponge fragments planted out Some are suspended from lines, others are confined in 'houses' to test the effect of the elimination of direct sunlight Regeneration of the fragments is remarkably rapid, the supporting cord being overgrown completely or partially in two days and the whole cut surface being overgrown in ten days The growth rate of the local oysters is being studied, while weekly gonad examinations of *Trochus niloticus*, *Holothuria atra*, and two species of edible oyster have been made regularly, artificial fertilisations being successful in all save the first He continues to take the temperature of the water in the anchorage twice daily, and this has risen as high as 33° C, very near the lethal temperature of corals During the recent low spring tides the temperature over the flat has risen above 35° C and a great many corals have been killed

Assisted throughout by Mrs Yonge and Mr A G Nicholls, I have been able to make very material progress with my work Little further work has been done on the feeding mechanisms of corals, but it has been found that *Favia* and *Galaxea* can digest planktonic organisms of 2 3 mm in length completely within twelve hours The symbiotic algæ of corals possess a well developed cellulose wall, have extensive reserve of fat, but no pure starch A number of suitable corals have been fed with a variety of substances and polyps fixed after appropriate intervals with suitable fixatives, for the later determination of the site and mode of absorption

FIG 2 —Interior of laboratory Plankton bench on left chemical bench in centre director s bench on right

The monthly experiments on the change of oxygen content in the water surrounding corals kept for similar periods in light and darkness have been continued, and confirmatory experiments on the length of time which corals can survive sealing in jars in the sea have been carried out A large light tight box with a detachable lid, containing a small trap door, has been cemented down on the reef flat, the object being to obtain data on the effect of continued darkness on the oxygen content and hydrogen ion concentration of the water surrounding the corals and clams (which also contain algæ) placed in the box

Work on the digestive enzymes of corals has been almost completed; extracts of the mesenterial filaments of *Lobophyllia*, and fluid from the cœlentera of large *Fungia* being studied In the former there is a powerful protease, of which the optimum hydrogen ion concentration has been found, an extremely weak lipase, and enzymes capable of digesting—very slowly—starch and glycogen but no other carbohydrate, the temperature of destruction and the optimum hydrogen ion concentration of the former have been determined Apparently the extract has no action on the symbiotic algæ Enzymes in the cœlentera of *Fungia* are confined to protease, apparently the only extracellular enzyme

Most interesting results have been obtained from the experiment on the effect of starvation and feeding on similar corals kept in light and darkness The starved corals receive twice filtered sea water twice daily, while the others receive unfiltered water to which is added every other night the results of a townetting *Fungia*, *Favia*, *Psammocora*, and *Galaxea* have all given good results, and demonstrated that fed corals continue in perfect condition in both light and dark, paling somewhat in the latter owing to the death of the algæ, but starved corals quickly begin to shrink in the tissues, undamaged algæ being extruded in great numbers and the tissues consequently turning pale This happens in both light and dark Newly settled planulæ of *Pocillopora* were placed in light and darkness, in both cases fed and after six weeks those in the light had abundant algæ, especially in the tentacles, while those in the dark, apparently just as healthy, were pure white with transparent tentacles The only conclusion to be drawn from these results, taken in conjunction with the experiments on the feeding and digestive enzymes of corals, is that the algæ are not and cannot be used as food by the corals

Mr A G Nicholls has not yet been able to record a second spawning of the pearl oyster, though several small spat from the November spawning have been found Measurements for growth rate have shown an increase of about 0 5 cm in diameter in 30 per cent of cases His work on calcium has shown that the calcium content of the sea water from the inside station has been remarkably steady, and that there is a noticeable diminution of calcium in water in which corals have been kept for periods of seven and fourteen days Mr G W Otter continues his work, previously outlined, on boring organisms

Mr Spender, who had the assistance of Mr E C Marchant until Jan 9, has been busily engaged on his large scale map of the island, a slow and laborious task Owing to the humidity causing distortion of the drawing paper, he has to plot all points by co ordination He has taken several traverses with the tacheometer between triangulation points, the fringe of the island being almost completely mapped, and hopes to fill in the central detail by plane tabling later He is running level traverses of a precise order across the flat

A preliminary bore with a hand plant has been made in the centre of the sand cay, 13 feet of casing being sent down, and although a level below that of the 'beach rock' was reached, nothing but sand was encountered

The tide gauge has been put up after great labour, entailing the erection, with the assistance of a member of the lighthouse staff, of three 30 foot mangrove poles in the form of a tripod This is giving excellent and most interesting results, and it is now possible to refer any point on the island to mean sea level, while sounding operations are also possible

At the time of writing, the work of the Expedition is being greatly extended by the hiring of a powerful Townsville launch, the *Magneta*, for plankton, hydrographic, and dredging cruises as far north as Cook's passage north of Cooktown

Obituary

COL E LESTER JONES

THE untimely death of Col E Lester Jones, on April 9, meant a loss to the scientific world of a friend and ally whom it will not be easy to replace Col Jones had been for fourteen years the directing head of the United States Coast and Geodetic Survey, and in that capacity had used his talent and energy to promote scientific work and investigation Much of the increased activity and interest in hydrography, geodesy, seismology, and terrestrial magnetism may be traced directly to his influence

Just as it is not possible to gauge the ultimate value of any single scientific discovery, just so is it out of the question to attempt an immediate appraisal of the importance of any one man's life work in the interests of science A hint of the monument Col Jones builded for himself may be found in the splendid organisation the destinies of which he guided for fourteen years The United States Coast and Geodetic Survey, pioneer Government scientific bureau, is to day functioning efficiently, it is well organised, well equipped, and making rapid forward strides For this, the credit must inevitably gravitate toward the man who led, ever encouraged, and efficiently aided its scientific staff

Col Jones was born at East Orange, New Jersey, on April 14, 1876 In addition to extended study abroad, he held an A B degree and an honorary A M degree conferred by Princeton University, and was commissioned a hydrographic and geodetic engineer In 1913 he was appointed deputy commissioner of the Bureau of Fisheries holding that position until being appointed the directing head of the United States Coast and Geodetic Survey by President Wilson in 1915

In addition to his administrative work with this latter bureau, he was the American member of the International Boundary Commission appointed to fix the boundary between the United States, Alaska, and Canada He had also been a member of several important Government and scientific missions One of the last of these was his appointment as a delegate to the twelfth International Geographical Congress held at Cambridge last year

DR CHARLES BEAVIS

THE sudden death of Dr Charles Beavis on April 17 at his residence, Naishcombe House, Wick, Bristol came as a great surprise to those who had recently seen him, apparently in the best of health and full of life and vigour He was born at Hampstead on May 3 1869 and educated at Atherstone Grammar School At the age of seventeen he went to Coblenz then to Bonn, where he read chemistry, physics, and mineralogy under Kekulé, Anschutz, Klinger Bendes, Clausius, and Hertz He afterwards proceeded to Würzburg, working under Emil Fischer, and in 1892 took the degree of Ph D (Magnam Laudem) He returned to London and worked for seven years with Dr Quirin Wirtz, during which time he took his F I C in 1897 In 1899 he went to Wick to start a fine colour department in the Golden Valley Ochre and Oxide Co, becoming manager in 1902, taking over the business in 1904 Although records of published original work are not available since his graduation, Dr Beavis had publicly identified himself with chemistry and the intricate problems of modern colour manufacture, and for many years took keen interest in the Colour Makers' Association of the United Kingdom, of which he was the first and only chairman

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WE regret to announce the following deaths

Prof John W Harshberger, professor of botany in the University of Pennsylvania and president in 1926 of the American Ecological Society, aged sixty years

Dr F C Madden, C M G, Dean of the Faculty of Medicine, Egyptian University, Cairo, an authority on bilharziosis and schistosomiasis, on April 27, aged fifty six years

Dr August von Schmidt, formerly director of the meteorological geophysical section of the Württemberg State Statistical Bureau at Stuttgart, on Mar 21, aged eighty nine years

Sir George Syme, K B E, president of the College of Surgeons of Australasia and chairman of the Royal Commission on Health, Commonwealth of Australia, aged sixty nine years

Dr Ludwig Wittmack, honorary professor of botany in the University of Berlin and author of the section on the Bromeliaceæ in Engler and Prantl's "Pflanzenfamilien", on Feb 2, aged eighty nine years

News and Views.

The nineteenth May Lecture of the Institute of Metals was delivered on May 7 by Sir Oliver Lodge who chose as his title Some Ideas about Metals A large part of the lecture was devoted to the subject of metallic conduction a theme selected by two of his predecessors by Sir J J Thomson in 1915 and by Prof H A Lorentz in 1925 but by no means exhausted even now Adopting the electron gas hypothesis as to the nature of metallic conduction Sir Oliver Lodge discussed in a fascinating manner the phenomena of thermo electricity and the Hall effect suggesting the lines along which a solution of outstanding difficulties may be pursued Great significance is attached to the results obtained by Kapitza in intense magnetic fields and it is conjectured that a flow along magnetic lines of force indicated by ether theory but too slow to be observed by existing means might be detected if such intense fields could be extended over a considerable region instead of being concentrated in a very small space The earlier part of the lecture however was of wider scope and dealt in a reminiscent vein with some of the anomalies of discovery in physics such as the failure to recognise a new phenomenon through excessive deference to existing views and the happy results sometimes derived from the exercise of boldness in experiment or speculation A wide range is covered by the lecture and the student of the history of physics will find an illuminating survey of some aspects of the growth of the Bohr atom among many thumb nail sketches of the physical discoveries of the present generation from the hand of a master of exposition who has himself been in close contact with such discoveries over the most interesting period in the whole history of the science

Science Service of Washington D C announces that fourteen Americans and five foreigners were honoured at the concluding session of the annual spring meeting of the National Academy of Sciences either by election to membership or to the foreign associateship Prof Arnold Sommerfeld of Munich known for his work on the quantum theory of spectra who attended the scientific sessions of the meeting as a guest, was one of the newly elected foreign associates The others included Richard v Hertwig professor of zoology and comparative anatomy in the University of Munich C de la Vallée Poussin professor of analytical mechanics at the University of Louvain, Willem de Sitter of the Observatory of Leyden, Holland, and Prof F O Bower formerly Regius professor of botany at the University of Glasgow

The new members of the National Academy are Dr Roger Adams, professor of organic chemistry at the University of Illinois Irving W Bailey associate professor of botany, Bussey Institution, Boston, Dr A. F Blakeslee, botanist at the Carnegie Institution s station for experimental evolution at Cold Spring Harbor, N Y, Dr James B Conant, associate professor of chemistry, Harvard University, Dr Bergen Davis, professor of physics at Columbia University, Dr C J Davisson physicist at the Bell Telephone Laboratories New York whose recent work on the wave nature of electrons has proved a most important advance in physics Dr Joel H Hildebrand professor of chemistry at the University of California Berkeley William Hovgaard professor of naval design at the Massachusetts Institute of Technology Dr Albert W Hull research physicist at the General Electric Company s Research Laboratory at Schenectady N Y Frank Leverett geologist of the U S Geological Survey and lecturer in glacial geology at the University of Michigan Ann Arbor Dr Paul W Merrill astronomer at the Mt Wilson Observatory Pasadena California Dr David H Tennent zoologist at Bryn Mawr College Pennsylvania Dr George H Whipple dean of the School of Medicine and Dentistry and professor of pathology at the University of Rochester N Y and Dr Clark Wissler curator of ethnology at the American Museum of Natural History New York and professor of anthropology in the Institute of Psychology at Yale

On Feb 13 last Mr Frederick Chapman palæontologist to the National Museum Melbourne retired from the State service and the National Museum Committee has passed a resolution recording appreciation of the services rendered by him since his appointment on Mar 12 1902 During his twenty seven years of tenure Mr Chapman has arranged and illustrated with his own pen and brush the two extensive galleries of fossils in the Museum identified 22 000 fossil specimens for visitors and registered about 14 000 exhibited specimens He has determined and labelled 7200 specimens in the reference collection of Australian fossils and apart from routine work has described many hundreds of types He is a member of the Australian Research Council and lecturer in palæontology at the University of Melbourne In March last he was elected president of the Royal Society of Victoria At present Mr Chapman is attached to the Commonwealth service as Federal palæontologist directing the examination of bore cores a work with which he is especially acquainted for forty years ago he was helping the late Prof J W Judd of the Royal College of Science to examine the borings from Meux s Well and from Richmond near London whilst only last year he published a work on the Sorrento Bore Mr Chapman s work is familiar through his writings on Foraminifera and on Australasian fossils and the recently published guide book to the Fossil Galleries at the Museum

The Central Electricity Board in accordance with the provisions laid down in the Electricity Supply Act of 1926, has published a report of its work up to January 1929 It will be remembered that the function of the Board is to co operate with the supply industry in Great Britain in reducing production costs to a minimum and concurrently to increase the availability of the supply The method of doing this which has been adopted is to interconnect the more efficient stations by a network of high pressure trans

mission lines, called the grid, and operate 'selected' stations in the most economic way The report indicates that good progress has been made in these directions Many difficulties have been tactfully overcome In central Scotland the Grampian Electricity Supply Company feared that the scheme would be prejudicial to its interests since it had counted on getting much of its revenue by supplying several industrial districts which will be connected with the grid The Board, recognising the importance of developing the water power of the country, has promised to take a load not exceeding a maximum demand of 12,000 kilowatts from the company

THE report goes on to state that in south east England the demand has increased so rapidly that three additional stations had to be selected by the Central Electricity Board The difficulties that were expected to arise owing to the standardisation of the frequency of the supply in central England and North Wales have been carefully considered, and in several cases the Board has given permission for schemes at a lower frequency to be completed, as the savings under the scheme would not have justified the higher expenditure The total value of the work contracted for under the Government scheme up to the end of last year exceeds eight million pounds In Scotland the erection of towers in the Clyde Valley will be completed this month In south east England towers are being built between Bedford and Little Barford, and forty six out of seventy three are now erected One very satisfactory feature is that many land owners have facilitated the work and co operated with the Board in preserving the amenities of the countryside by choosing the most suitable sites for the towers

AT a recent meeting of the Council of the Institution of Professional Civil Servants the announcement of the appointment of a Royal Commission on the Civil Service, with the wide terms of reference indicated by Mr Churchill in the House of Commons, was considered While welcoming such a Royal Commission, the Council is of opinion, however, that such an inquiry can only discharge the task imposed upon it satisfactorily provided that professional and scientific men of standing and administrative experience are appointed to serve on the Commission In its view, the problem of the structure of Civil Service organisation must be approached afresh in relation to the functions which should be accorded to the 'technical expert' in the administrative machinery of the modern State An approach from the traditional Civil Service point of view is considered unlikely to lead to those fundamental changes which are rendered necessary by modern conditions

IN a reprint of certain articles published in the *Journal* of the American Society for Psychical Research during 1928, and now issued under the title of "The Thumbprint and Cross Correspondence Experiments made with the Medium Margery during 1927 and 1928," Dr Mark W Richardson and his associates have collected some of the more striking episodes in the later history of the development of the alleged supernormal phenomena occurring with the Boston medium, Margery (Mrs L R G Crandon) The paper is divided into two sections, one dealing with the thumb impressions upon dental wax which have so far been traced to no living person, and the other to the series of cross correspondences between Margery and other mediums, which have the merit of simplicity, and possess a degree of accuracy which would be regarded with suspicion if it represented any kind of scientific result There is little doubt that, merely considered as a question of mechanical production, the thumb prints are of some interest Unlike the prints which engage the attention of the police, the Margery impressions are made in wax, and are therefore capable of more detailed examination and analysis than are those of two dimensions Moreover, the fact that these wax impressions are said to be negative *and* positive together with 'mirror' images of both these series serves to illustrate the complexity of the problem

THESE wax originals are open to inspection in Boston, and it is clear that an examination of them would be more satisfactory than of the photographs here included, excellent though the latter undoubtedly are Hence any detailed criticism would be out of place, although it ought to be said that in the account there are certain suspicious incidents which again are not absent in the records of the cross correspondences Here we have broadly what is claimed to be the transmission of an idea independently chosen and presented which is reproduced at approximately the same time by two or more mediums at widely separated distances Such a claim lends itself to scientific scrutiny, and it would appear that, under much stricter conditions than those described in this paper, it might be possible to test these phenomena in a manner free from those objections which usually prevent any adequate examination of supposed 'psychic' manifestations

THE Right Hon W Ormsby Gore, Under Secretary of State for the Colonies, recently gave an address before the Royal Scottish Geographical Society on the "Development of our Tropical Dependencies", and the lecture has now been published in the Society's magazine He points out that in the true equatorial territories the combination of high rainfall, perpetually humid atmosphere, and comparatively high temperatures, provides all the circumstances necessary for constant and rank vegetable growth On the north and south, these regions are bounded by great torrid deserts with a rainfall lower, and a temperature far higher, than those found in the true equatorial belt The wealth of the tropics lies mainly in the production of certain foodstuffs and raw materials, which are becoming of increased importance year by year Despite the bountiful and productive nature of the true equatorial regions, there is, however, an extraordinary sparseness of human population A variety of causes retard development, among which the more important are tropical diseases, the ravages of mosquitoes and tsetse flies which attack man and animals, and the prevalence of plant diseases For

the development of the tropics, further research work in tropical medicine and veterinary science is all important In agriculture, also, research is vital since immune varieties of higher yielding strains of particular crops are urgently required Mr Ormsby Gore considers that it is in the fields of economic botany, plant genetics, and soil science that the economic conquest of the tropics has its future In tropical agriculture, medicine, and veterinary science the main problems now to be faced are not so much the cure of diseases as and when they arise but rather the eradication of disease and the maintenance in health of men, animals, and plants

THE first number of *Human Biology*, a new magazine with a definite and specific aim, has made its appearance from the Institute for Biological Research, under the editorship of Prof Raymond Pearl Its object is to publish in readable English original articles in all fields of human biology, including physical and general anthropology, anthropometry, vital statistics, human heredity and eugenics, prehistory, human anatomy, sociology, constitutional pathology, and psychobiology There was need for such a work, for not only has it become increasingly apparent that humanistic researches must all wander into biological fields, but also the publication of papers on human biology found their way into many and scattered journals, and lost the value of a massed attack The first part—the journal is to be a quarterly —contains a varied series of papers, dealing with subjects from human evolution to biological philosophy and medicine All the articles are stimulating in their suggestiveness, but a perusal of some suggests that the editor is to have a hard task to capture the standard of thorough and entertaining readableness at which he aims through his contributors There are no book reviews, but a list of new books and memoirs received at the editorial office is printed as a bibliographical guide There is a niche for *Human Biology*, and this it promises to fill very satisfactorily

DR FRANK B JEWETT, of New York, who has recently been honoured by the American Institute of Electrical Engineers, gave an address on Dec 29 last to the American Association for the Advancement of Science, which has appeared in a recent issue of *Science*, on leadership in industrial research As one of the founders of the Bell Telephone Laboratories, and as one who has been engaged for the last twenty five years in finding and encouraging others to do scientific research in industry, his paper deserves consideration by scientific and technical professors He has worked all his life to promote co operative research, not with any idea of banishing the individual inventor, especially if that inventor happens to be a genius, but in the belief that co operation provides a new method of research In both scientific and industrial research the men who succeed are driven to work by insatiable curiosity about natural laws and not mainly by a desire for personal wealth Looking back over his successes and failures in selecting young men for industrial research during the last twenty five years, Dr Jewett says that the majority of his successes were secured by attaching one third weight to his own personal appraisement and two thirds to that of experienced professors under whom the candidate had worked His failures were mainly due to paying too little attention to the professorial opinion and to attaching too much weight to those whose judgment he should have distrusted In order to promote the peace of mind and the continued productivity of the research worker, it is necessary to encourage him by a sympathetic understanding of the work he has done and the obstacles he has to overcome We are human beings dealing with each other, and no hard and fast rules can be applied to workers in the field of research any more than in any other field of activity

A FURTHER Circular (No 6) has been issued by the secretaries of the International Congress of Forestry Experimental Stations to be held in Stockholm next July, which has been referred to in previous issues of NATURE So far, about a hundred applications to attend the Congress have been received and fifty papers have been presented to be read, the latter chiefly from Europe and the United States It is proposed to set up an organising committee, consisting of one representative from each country, which will deal with questions concerning the organisation of the Congress and the revived International Association of Experimental Stations This Committee will have the power to summon experts to its meetings, which will not clash with the general meetings of the Congress, to assist in the solution of such problems as may arise, small executive sub committees will be appointed when deemed necessary Delegates submitting papers are requested to send in a précis of their papers at once, in order that such summaries may be printed and thus be in the hands of delegates before the meetings at which the papers are read It is further announced that the period of application to attend the Congress has been extended to June 1, although the date of giving notice regarding attendance at the excursions to take place before and after the Congress meetings was left at April 30 The meetings in Stockholm will take place on July 22–27 The first meeting of the organising committee will be held in the afternoon of Sunday, July 21, and this will be followed by a garden party at the beautifully situated College of Forestry at Stockholm, to which all delegates are invited The proceedings of the Congress will open on July 22, and the programme of the first two days' meetings is given in the circular The last meetings of the Congress will be held on Saturday, July 27, when resolutions will be submitted, the election of a president, and the time and place of the next meeting, and the appointment of an executive committee of the Association will be discussed

IN a recent issue of *Science*, Prof Knight Dunlop has a paper on the outlook for psychology, presented before the New York meeting of the American Association for the Advancement of Science He reviews the present situation with special emphasis on what he calls the laboratory method, believing that the laboratory is the centre of true psychological activities It is dis-

appointing that such a subject should be treated so generally, he asserts, but presents no evidence, that the laboratory method has justified itself and contrasts it with the mental test movement and the psycho analytic movement, both of which he looks upon as in a state of eclipse One cannot help feeling either that the position of psychology in the United States is radically different from what it is in Britain, or that Prof Knight Dunlop is comparing the best work of the laboratory with the worst and most uncritical of the practical movements There is no inherent opposition between the laboratory method and scientific method pursued in the field for practical purposes The laboratory worker in psychology as in any other science, can pursue knowledge for the sake of knowledge, regardless of possible practical applications, but he can also receive his stimulus to work from the practical side and pursue his research scientifically with a practical aim The mental tester in his domain and the doctor in his, were confronted with serious problems Neither of them could wait until, if ever, the laboratory worker bestirred himself to help him Because both movements have had over enthusiastic exponents and reckless theorisers, one cannot look upon them as discredited So also has the theory of evolution Perhaps in England less was expected of either mental testing or psycho analysis, and therefore they have been kept in better perspective In the latest edition of Osler and M Crae s Modern Medicine , there occurs the statement "Psycho analysis is of the greatest service for the strictly psychogenic cases and the mental test is used not as a method of universal validity, but as a convenient measure of differentiation

THE effect of the erection of overhead power lines on the beauty of the countryside has been much discussed in the Press Electrical engineers are, however more concerned at present with the possible interference these high voltage lines may produce with telephone lines, radio transmission, and broadcast reception Dr R L Smith Rose has been experimenting, on behalf of the Radio Research Board, at the National Physical Laboratory on this subject and has arrived at definite conclusions These are given in the *Wireless World* for May 8 American experience has shown that if the radio reception station be farther than about half a mile from a high tension overhead line, no interference or disturbing effects will be experienced The station itself may, without causing interference, be supplied with power from the overhead system Experiments were made by Dr Smith Rose to find out the effects of high voltage spark discharges on a sensitive radio receiver in the neighbourhood When a spark or arc discharge initiated by a voltage of about 850,000 and carrying a current of about half an ampere took place, then if the receiver were less than 200 yards from it, disturbance ensued This effect was only serious when long drawn arcs occurred at frequent intervals, a phenomenon which would very rarely happen on transmission lines When the distance was so great as 600 yards, the interference was negligible The distance, therefore, of half a mile which is customarily chosen for other reasons ensures that the disturbing effects produced by man made static' are negligible

TEST transmissions of the new Marconi broadcasting station at Bratislava, Czechoslovakia, have been carried out and satisfactory reception has been reported generally on three valve sets, from all parts of the British Isles The new station comprises a Marconi 12 kilowatt broadcasting transmitter, Type P A 5, employing the principle of low power modulation Its wave length is 277 8 metres (1080 kh), and among its special features is the half wave length aerial, the first of its kind to be used in the broadcast band of wave lengths The station, which is situated about three miles to the east of the town, replaces an old broadcasting station of ½ kilowatt power It is connected by land line with up to date studios in the centre of Bratislava Prague, and Brno

THE Fourth World s Poultry Congress is to be held at the Crystal Palace on July 22-30, 1930 It is being organised by the English Ministry of Agriculture and Fisheries in conjunction with the Scottish Department of Agriculture and the Ministry of Agriculture for Northern Ireland The official host is the Government and Their Majesties the King and Queen and H R H the Prince of Wales have consented to become its patrons National committees have been formed in most countries for the purposes of organising national exhibits, and of selecting papers to be read at the Congress The business activities of the Congress will consist of paper reading sessions national displays of live stock, and commercial exhibits Whilst most that is to be heard and to be seen will deal with the democratisation of information relating to poultry keeping there are to be in addition special paper reading sessions devoted to the presentation and discussion of original scientific contributions in genetics dietetics, pathology, and husbandry This Congress is expected to be no less successful than the last, which was held at Ottawa in 1927, when 3000 delegates and 200 000 members of the general public attended

A FORMIDABLE and very widely spread insect pest of fruits, namely, the Mediterranean fruit fly (*Ceratitis capitata*), has recently, and for the first time secured a footing in the United States We learn from recent *Daily Science News Bulletins*, issued by Science Service, Washington, D C , that its discovery in citrus orchards in Florida, over an area of about 40 square miles, has led to the planning of energetic measures of repression The fly was first found on April 6 and its identity established soon afterwards Specimens were then rushed by air mail to Washington and the identification confirmed It is stated that within one week of the date of discovery, 75 entomologists and plant experts were on the ground, and the battle of extermination has begun !

THE Bakerian Lecture of the Royal Society will be delivered by Prof E A Milne, Rouse Ball professor of mathematics in the University of Oxford, on June 6, the title being "The Structure and Opacity of a Stellar Atmosphere"

At the annual meeting of the members of the Royal Institution, held on May 1, the following officers were elected :—*President*: The Duke of Northumberland; *Treasurer*: Sir Robert Robertson; *Secretary*: Major Charles E. S. Phillips.

The President of the French Republic has, on the recommendation of the Association Technique Maritime et Aéronautique, conferred the Legion of Honour upon Mr. Robert W. Dana, secretary of the Institution of Naval Architects.

The first Pedler Lecture of the Chemical Society will be delivered by Prof. W. H. Perkin, Waynflete professor of chemistry in the University of Oxford, on Thursday, May 30, at 5.30 P.M., the title of his lecture being "The Early History of the Synthesis of Closed Carbon Chains". The lecture will be given in the hall of the Institution of Mechanical Engineers, Storey's Gate, London, S.W.1. Tickets of admission will not be required.

'National Baby Week' is to be celebrated this year in Great Britain on July 1-7. The National Baby Week Council desires that special attention should be directed to three problems: (1) The practical measures that can be taken to combat maternal mortality, morbidity, and disability; (2) what local authorities and parents can do to lessen the incidence and dangers of infectious diseases among young children; and (3) the teaching of parentcraft and hygiene to school children. Particulars may be obtained from the Secretary, Miss Norah March, 117 Piccadilly, W.1.

A publication grant of £2500 is receivable by the Royal Society from H.M. Government during the current year. The grant is available for assisting the publications of other scientific societies, as well as for assisting the separate publication of books, memoirs, etc., of a scientific nature. Applications for grant will be adjudged by the Council of the Royal Society at its meeting early in July, but should be received before the Council meeting of June 13. Applications from societies will be received by the secretaries of the Royal Society; those from individuals must be brought forward by members of Council.

The second meeting of the Internationale Gesellschaft für Sexualforschung will be held in the house of the British Medical Association, Tavistock Square, London, on Aug. 3-9, 1930. It may be assumed that, as was the case in Berlin, the papers presented for discussion will fall into the following groups: biology, physiology, pathology, and therapeutics; psychology, pedagogy, ethics, æsthetics, religion; demography, statistics, social and racial hygiene; sociology, ethnology, and folk lore. All arrangements are in the hands of Prof. F. A. E. Crew, The University, West Mains Road, Edinburgh, to whom all those who are interested are requested to write.

The cheap popular series of books which have long been a feature of publishing enterprise fall into two main divisions; those which have long attained the rank of classics, and those which provide expositions, brief but authoritative, of new problems, or of problems which have assumed new forms or a new importance. Of the latter kind of cheap series, "Benn's Sixpenny Library" is one of the most remarkable (London: Ernest Benn, Ltd.). To mention three examples, rather wide apart as to subject matter, from a number of volumes which have recently reached us—Dr. Cyril Norwood on "The English Educational System", Mr. F. N. Fallaize on "The Origins of Civilisation", and Lord Monkswell on "Railways"—is to convey some idea of the comprehensiveness of the series. Many of the volumes dealing with scientific subjects have been noticed separately in Nature. As at present arranged, the series is to run to some two hundred and fifty books, of which we have already received about a hundred and fifty. The undertaking is one which deserves, and we trust is commanding, success.

A correspondent in Tanganyika has directed attention to an error in the provenance of the wooden dolls described in Nature of Mar. 9, p. 388, where they are attributed to West Africa. This should be East Africa, as the Wamakonde, by whom the dolls were made, are native to Portuguese East Africa.

Applications are invited for the following appointments, on or before the dates mentioned:—A soil analyst in the West of Scotland Agricultural College —The Secretary, West of Scotland Agricultural College, 6 Blythswood Square, Glasgow (May 24). An assistant lecturer in chemistry and an assistant lecturer in biology at the Brighton Technical College —The Secretary, Brighton Technical College, 54 Old Steine, Brighton (May 25). An assistant at the Forest Products Research Laboratory, Princes Risborough, for work on the identification and structure of wood—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (May 25). Temporary assistant chemists at the Government Laboratory—The Government Chemist, Clement's Inn Passage, W.C.2 (May 25). An assistant master to teach mathematics at the Toxteth Junior (Day) Technical School—The Director of Education, 14 Sir Thomas Street, Liverpool (May 25). A part-time demonstrator in chemistry at King's College of Household and Social Science—The Secretary, King's College of Household and Social Science, Campden Hill Road, W.8 (May 29). A demonstrator in the mechanical engineering branch of the Military College of Science, Woolwich—The Assistant Commandant, Military College of Science, Woolwich, S.E.18 (May 31). A pathologist and curator at the Royal London Ophthalmic Hospital—The Secretary, Royal London Ophthalmic Hospital, City Road, E.C.1 (May 31). An assistant lecturer in physical chemistry in the University of Sheffield—The Registrar, The University, Sheffield (June 3). A demonstrator in the department of physiology of Middlesex Hospital Medical School—The School Secretary, Middlesex Hospital Medical School, London, W.1 (June 5). A professor of mechanical engineering at the College of Engineering, Guindy, Madras—The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, S.W.1 (June 8). A research chemist in the department of Coal Gas

and Fuel Industries of the University of Leeds—The Registrar, The University, Leeds (June 9) A lecturer in civil engineering in the University of the Witwatersrand, Johannesburg—The Secretary, Office of the High Commissioner for the Union of South Africa, South Africa House, Trafalgar Square, W C 2 (June 11) Two research fellows in the Department of Chemical Technology of the Imperial College of Science and Technology for work in connexion with the carbonisation of coal, gaseous combustion or catalytic reactions—The Registrar, Imperial College of Science and Technology, South Kensington, S W 7 (June 15) Three assistants in the Research Department, Woolwich, under the Directorate of Explosives Research—The Chief Superintendent, Research Department, Woolwich, S E 18 An examiner in the Aeronautical Inspection Department, Air Ministry, Kidbrooke, S E—The Secretary (I G), Air Ministry, W C 2 A temporary woman lecturer in geography at the Warrington Training College, temporarily at St John's College, Battersea—The Principal An assistant in the Public Health Laboratories and Bacteriological Department of the University of Durham College of Medicine—The Registrar, University of Durham College of Medicine, Newcastle upon Tyne

Our Astronomical Column

The Total Solar Eclipse of May 9—Unfortunately, the news from the official British parties at Alor Star and Patani are very disappointing At the latter station nothing could be done owing to thick clouds At the former the clouds were thinner, and some plates were exposed, but it is feared that they will be of little value

Fortunately, the parties in Sumatra and the Philippines had better conditions Iloilo (Philippines) was occupied by American and German parties from the Naval Observatory Washington, and from Hamburg There were also two English observers, Dr R L Waterfield and Mr W Lloyd There was a little high cirrus cloud here, but it does not appear to have interfered much with the observations, there was a fine flag shaped prominence, which the Americans humorously compared to the Stars and Stripes The corona was of maximum type and had six pointed streamers, Dr Waterfield reports that it was brighter and more extensive than that of June 1927, but the darkness during totality was not so great He states (*Daily News* May 11) that the infra red plates overcome thin clouds and give the corona a harder outline, but no greater extension, than ordinary plates A kinematograph film was exposed during totality by the Washington party, but this had not then been developed

Some of the parties in Sumatra report some interference by cloud while others enjoyed very good conditions Prof J A Miller, of Swarthmore Observatory, who probably holds the record for the number of eclipses he has observed, took coronal photographs with a camera of 65 feet focus, comparison of his plates with those taken in Iloilo will reveal any coronal changes that may have taken place in an hour Prof E F Freundlich, from Potsdam, has telegraphed that he obtained successful results He was studying the Einstein bending of light, a problem on which he was engaged even in pre War days, before the publication of the general theory of relativity This is the third totality that has been successfully observed in Sumatra in the present century, the others were 1901 and 1926

Since the above was written, a Reuter telegram received from Dr Jackson at Alor Star reports as follows Developed plates better than anticipated Transparencies equal to that of Giggleswick Several beautiful prominences, one 150,000 miles long, 100,000 miles high, with coronal arches Apparatus for velocity in the corona satisfactory

The Pleiades—At the meeting of the Royal Astronomical Society of May 10, the George Darwin Lecture was delivered by Prof Ejnar Hertzsprung, of Leyden Observatory He chose as his subject the Pleiades, and began with describing the methods by which the stars of the cluster could be discriminated from background stars by photographic determinations of their proper motions Slides were shown of the proper motions of each magnitude of stars from the third to the fifteenth The brighter ones are all cluster stars, it is only in the case of the faintest stars that any doubt arises as to which belong to the cluster, and even here there are only one or two doubtful cases

Prof Hertzsprung then proceeded to divide the stars into the spectral classes, which was done for the fainter stars by their colour indices There are no red or yellow giants the brightest stars being of type *B*, and the faintest being red dwarfs Prof A S Eddington remarked after the lecture that the resulting diagram of spectral type and absolute magnitude brought out the 'main sequence' more vividly than he had seen before, since it was the first time that such a large number of stars, all known to be at the same distance, had been studied The globular clusters are too remote for the dwarf stars in them to be seen The colour indices of the non cluster stars in the region were also determined, there was some reason to think that they were rather redder than the average, which might possibly be caused by the presence of the nebulosities round the principal stars

Prof Hertzsprung adopted the parallax of the cluster as 0 0065", which is smaller than some other estimates, which go up to 0 01" He ascribed the proper motion almost entirely to the motion of the solar system

Measuring the Heat of the Stars—The May *Scientific American* contains an account by Prof H N Russell of the very delicate measures of stellar heat made by Messrs E Pettit and S B Nicholson with the 100 inch reflector at Mount Wilson The wires of the thermocouple are about one thousandth of an inch in diameter and weigh 1/600 of a grain Betelgeuse is the star that gives us the most heat, but even this only raises the temperature of the wire on which it falls by 1/60 of a degree, and produces a current of one seven millionth of an ampere This, however, suffices to move the spot of light reflected from the mirror of the galvanometer through 18 inches Some stars invisible to the naked eye give a measurable displacement The next in order after Betelgeuse are Antares, Sirius, Canopus, Gamma Crucis, Arcturus, Alpha Herculis, Aldebaran, Mira at its maximum It is noted that a very red star, such as Alpha Herculis, sends us 50 times as much heat as a white star of the same visual magnitude, in spite of the fact that the surface temperature of the first is only 2300°, that of the second being 6000° The article contains a picture of the thermocouple used by Dr W W Coblentz for measuring the heat received from the planets

Research Items

The Religion of Mentawei.—Mentawei Islands, lying west of Sumatra, owing to political conditions, have received more attention from Dutch and German than from English speaking ethnologists. They were, however, visited in 1926 by Mr. Edwin M. Loeb, as a research scholar of the University of California, and he has now published an account of the religious organisation of the Pageh group of islands in the *Publications in American Archæology and Ethnology*, vol. 25, No. 2 of that University. He deals more especially with the *punen* system. The *punen* is the community religious festival (as distinct from the *lia* or family festival) which is attended by all members of the *uma*, the communal house. The festival is of long duration, sometimes lasting for years. It takes place at the building of a new communal house, the choice of a new priest, the making of a new field, the spilling of blood in the village, an epidemic, and so forth. The main ceremonial acts are the slaughter of pigs and chickens, the sacrifice of their livers and haruspication. The souls of the dead members of the *uma* are invoked to return, and imitative dances are held, and towards the end of the festival monkeys, deer, and sea turtle are hunted. All men sleep in the *uma* and sexual intercourse is taboo. The religious beliefs of the Mentawei Islands are animistic. They believe in nature spirits, souls, and ghosts; but the nature spirits, with a few exceptions, are not given names. They are the spirits in the sea, the jungle, and so forth. The exceptions are a god who causes earthquakes, the original meaning of his name being 'grandfather'. It is on account of this god that a human sacrifice used to be offered at the building of the *uma*. Other specially designated gods are two water spirits, the first being propitious if due sacrifices are offered and no ritual sin has been committed, and the second is evil. The soul cult is specially directed to the preservation of health and long life, while ghosts are the bringers of disease to whom prayer is offered for purposes of witchcraft, and to whom sacrifice is made only when they have entered a village bringing sickness, to induce them to go away.

The Regent's Park Medusa.—Prof. C. L. Boulenger and W. U. Flower (*Proc. Zool. Soc.* Part 4, 1928) record observations on the freshwater medusa, *Craspedacusta* (*Limnocodium*) *sowerbyi*, which reappeared in the *Victoria regia* tank in the Royal Botanic Society's Garden in Regent's Park in 1928 (see also Nature, July 14, 1928, p. 58). The youngest specimens—about half a mm. in diameter—agree in structure with the description of American examples of the medusa of *Microhydra ryderi*. The latter is therefore merely the young stage of *C. sowerbyi*. The description given of *Microhydra germanica* shows that it corresponds with the young forms of *C. sowerbyi*, and the Chinese species *Limnocodium kawaii* is also a synonym. The Japanese *C. iseanum* is clearly differentiated by the structure of its sense organs. The living *C. sowerbyi* passively sinks in the water, the velum hanging downwards from the umbrella margin and the tentacles floating upwards, the lip of the oral opening of the elongate manubrium being widely extended so as to catch organisms. In addition to this 'tow net' method of feeding the medusa can feed on bottom living forms, for the stomach has been recorded filled with *Arcella*. The authors consider that the increase in size of the mouth and the large manubrium of *Limnocnida* show that this genus has become more perfectly adapted to the tow net method of feeding, but the radial canals are shortened and the sex cells remain in the manubrial ectoderm, that is, in the primitive position in which they first appear in the young *Craspedacusta*.

The Muskrat in Europe.—In 1905 the American muskrat (*Fiber zibethicus*) was introduced into Bohemia on an estate near Prague, where it was hoped that it would breed and help to supply the demand for musquash fur which was then in fashion. The experiment succeeded better (or worse) than was expected, for the colony burst out of control and soon mid Bohemia was overrun. About 1914, Bavaria and Saxony were invaded, in 1924 Silesia, and in 1928 the outposts were still spreading (Hj. Broch in *Naturen*, January 1929). The extent of the conquest may be judged by the fact that in 1921, 60,000 to 80,000 muskrat skins were sold in Berlin at prices which compared favourably with those obtained for American skins. Such an invasion could not but have its ill effects. The muskrats, largely vegetarians, have attacked corn, potatoes, kohlrabi, turnips, and carrots. They have extended their carnivorous diet to frogs and fish, and the damage caused by their burrows to road and railway works has not been negligible. Strenuous measures have been adopted against the pest in the affected countries; in Bavaria special muskrat catchers have been appointed. The whole story is but another illustration of the danger of introducing animals in casual and unconsidered ways to new countries, and it strongly supports Dr. Broch's plea that there should be no relaxing of the law forbidding the importation of live muskrats into Norway.

Animal Hypnosis.—J. ten Cate (*Biol. Zentralbl.*, Bd. 48, Heft 11) discusses the problem of animal hypnosis. Czermak (1856) found he could produce complete immobility in the newt by suddenly seizing with forceps a leg or the tail. Similar immobility after a sudden strong stimulus is met with in other animals, especially in insects, and is known even in a few mammals. But there are other cases in which the hypnotic condition is brought about by much weaker stimuli lasting for a longer period, for example, in consequence of holding the animal, by the suppression of the reactions of flight, defence and turning over, by transient pressure on definite parts of the body, by continuous gentle contact, etc. Hypnosis in these cases appears only under quite definite conditions and its origin is by no means so simple as has been assumed. The author describes experiments with the skate, the cockroach, the salamander, the rabbit, and the octopus, in which hypnosis was produced by the action of definite stimuli. He proceeds to refer to the condition of the musculature and to discuss the origin of hypnosis in animals. He concludes that in the vertebrate series the significance of the cerebrum for the realisation of the condition of hypnosis becomes the more important according to the higher grade of development of the central nervous system. Among the invertebrates the general rule appears to be that the higher the animal the more significant are its cerebral ganglia in regard to the origin of hypnosis.

Chromosomes of Maize.—A useful study of chromosome numbers in many different varieties of maize has been made by Randolph (*Memoir* 117, Cornell Univ. Agric. Expt. Station), who used the iron aceto carmine method. All the different types of maize, including dent, flint, pop, and sugary, were examined,

including both meiotic and somatic chromosomes, and the chromosome counts in 338 plants were determined In accordance with previous work, the typical diploid number was found to be 20 in all varieties But plants with a higher number were found in two sugary and two starchy varieties, and in certain other cultures In the exceptional cultures the numbers ranged from 21 to 28, but were constant in each individual, with rare exceptions The chromosomes vary in length from about 2 microns to 4 5 microns, and the extra chromosomes were of the smaller size Segmentation, fusion, duplication through non disjunction, and hybridisation are discussed as methods by which the additional chromosomes may have arisen, but further studies are necessary before the exact method can be determined

SOFT WOOD IMPORTS INTO NEW ENGLAND —Much has been read of the threatened famine in soft wood coniferous timber supplies, and the matter is admittedly one deserving the closest attention The intricacies of the question are very considerable, both in the Old and the New Worlds A point bearing on this matter was discussed by Mr Franklin W Reed, of the National Lumber Manufacturers' Association, at the recent New England Forestry Conference (*Daily Science News Bulletin*, Science Service, Washington, D C) Mr Reed stated that shipping lumber to New England, traditionally a forested region, seems like carrying coals to Newcastle , yet lumber is being shipped into the State and no tariff wall can keep out the invading lumber, for it is American lumber from the Pacific north west It comes into the New England market, partly because the digging of the Panama Canal has made intercoastal freight rates cheap, and partly because the Pacific lumbermen have been caught in an economic trap of overproduction and have to dispose of their product at abnormally low prices in order to maintain their establishments "The present unfavourable condition, from the point of view of the New England producer, will end", said Mr Reed, "when the excessive exploitation of the virgin stands of the Pacific coast is ended, either through agreement among the lumbermen or through exhaustion of the more easily accessible timber" Although New England may look with equanimity to such exhaustion, it would prove a serious matter for wider United States and world markets In the meantime, however, New England timber owners and lumberers are advised to consider the possibility of exporting hardwood products to the Pacific States via the Panama Canal This section, it is pointed out, though possessing a surplus of soft woods, has almost no hardwood resources and is now importing oak from Japan It appears possible, therefore, that an exchange of New England birch, beech, and maple for Pacific Coast soft woods might prove an economic possibility

WATER COOLED MERCURY VAPOUR LAMPS —The Lummer and Straubel mercury vapour lamp, which furnishes a very bright light source of small extent and proves most useful in spectroscopic work and as a subsidiary to devices for obtaining monochromatic light, has the disadvantage that it requires to be cooled in a current of water In the *Rendiconti* of the Royal Lombardy Scientific and Literary Institute for 1928, Dr Luigi Piatti, of the University of Pavia, describes a simple arrangement, which both prevents the lamp from coming into action unless the water is flowing and extinguishes it automatically if the water supply fails Moreover, the arrangement is such that the electric circuit in which the lamp is inserted is kept well insulated from the cooling water

FUNDAMENTAL CONSTANTS —Prof A S Eddington's theory of the relation between certain of the fundamental constants, to which several references have been made in NATURE this year, lends particular interest to two new numbers which have been published recently H Feder, working in the late Prof Wagner's laboratory at Würzburg, who has remeasured Planck's constant h by a method based on the excitation of the continuous X ray spectrum, now finds for it a value of $6\ 547 \pm 0\ 003 \times 10^{-27}$ erg sec H D Babcock, of the Mount Wilson Observatory, has revised a previous estimate of the specific charge of the electron (e/m) which he had made from the magnitude of the Zeeman effect for a number of spectral lines of known spectral types, and gives as its value $1\ 7606 \pm 0\ 0012 \times 10^7$ e m u /gm In each case the changes called for in the older standard values are less than one part in a thousand, although it has to be remembered that the former method presupposes a knowledge of the actual charge on an electron (e), and the latter a knowledge of the velocity of light The accounts of the two investigations are published in the *Annalen der Physik* (vol 1 No 4), and in the January issue of the *Astrophysical Journal* respectively

QUANTUM MECHANICS —Dr P A M Dirac has reviewed some of the more recent developments of quantum theory very lucidly in the introductory paragraphs of a paper in the issue of the *Proceedings of the Royal Society* for April 6, on the properties of many electron systems Quantum mechanics is defined as "the general theory of all quantities that do not satisfy the commutative law of multiplication" Dr Dirac considers that the general theory is now almost complete, apart from the question of the exact form in which relativity considerations have to be introduced The latter, however, are only of importance where high speed particles are concerned, and so the underlying physical laws necessary for the mathematical formulation of a large part of physics and the whole of chemistry may be regarded as completely known the difficulty is only that insoluble equations are frequently encountered in the applications of these laws to specific systems Dr Dirac has given a sketch of the history of the spinning electron which brings out clearly the nature of the problem presented by the interaction of the orbital electrons of atoms and of molecules, and the way in which the impasse which this presented was removed by recognition of the fact that the electrons are actually indistinguishable one from another, and so can change places without our knowledge This 'exchange' type of interaction leads also to satisfactory theories of homopolar valency and of ferromagnetism Dr Dirac's main object in this paper has been to take the ideas and results of group theory, which has been used extensively by German theoretical physicists, and to translate them into the more general and apparently simpler language of quantum mechanics, a transformation which appears to have the additional advantage that it often enables a simple physical meaning to be attached to an otherwise abstract theorem

GRID CONTROL IN ARCS —I Langmuir and A W Hull have contributed a paper to the March number of the *Proceedings of the National Academy of Sciences* of the United States, from which it would appear that considerable developments in the use of enclosed arcs may be expected in the near future The principle underlying the construction of the new tubes is the combination of grid control of the current from a hot cathode with conduction through an ionised gas, with the essential reservation that a

circuit can be made by raising the potential of the grid, but cannot be broken by again lowering it, a negative grid in a strongly ionised medium simply attracts to itself a thin sheath of positive ions, which act as a perfect electrostatic shield to the main body of the discharge To stop a current flowing, the anode potential must be reduced to the neighbourhood of the ionising potential of the gas, and hence the grid does not affect the instantaneous value of the anode current, but only its average value The action of the grid, once a discharge has been started, is in fact the same as that of the small exploring electrodes that are now used in the investigation of many types of gaseous discharges More details of the arc tubes are being given by Dr Hull in a series of articles in the *General Electric Review* Perhaps the most remarkable feature of the first of these—in the April number—is the shape which is now being given to the electron emitting surfaces of the cathodes The bare filament type has been almost abandoned, and there has been substituted an elaborate structure of appropriately coated ribbons or vanes, in the design of which special care is taken to ensure that the emitting surface is efficiently insulated thermally These tubes have already been made in metal, as well as in glass

BREEZE AND CLINKER AGGREGATES —Concretes made from furnace residues as aggregates often develop cracks within a short time of setting, and the causes of such failures have been investigated at the Building Research Station The experimental methods employed and the results obtained are described in detail in *Technical Paper, No 7*, by F M Lea (London H M Stationery Office) Many breezes and clinkers contain combustible matter and even unburnt coal, and it is this material that is, in general, responsible for failure The absorption of moisture and the oxidation of the coal cause swelling movements which may continue over a period of some days, and are particularly noticeable during the setting period and early life of the concrete The presence of more than 40 per cent of combustible material in the breeze invariably results in a low grade concrete, and the properties of the concrete improve as the combustible content decreases Failure due to the presence of sulphur or its compounds appears to be rare, and up to 0 4 per cent of sulphur as sulphate and 0 75 per cent in other forms, is permissible Other impurities do not appear to cause failure

A METHOD OF PRODUCING SOUND STEEL INGOTS — In a paper read before the Iron and Steel Institute on May 3, Sir Charles Parsons and H M Duncan described an experiment carried out on a large scale to produce steel ingots of exceptional soundness The mould used consists of a strong steel casing lined with specially shaped firebricks and is closed by a cover similarly constructed and a bottom chill of steel or cast iron of large dimensions Through the cover are openings for the pouring of the steel, the escape of gases, and for the insertion of oil burners to keep the surface of the steel hot In this way the metal is constrained to solidify from the bottom upwards, and not, as in the ordinary ingot, from the sides inwards The ingots produced, weighing as much as 20¼ tons, are, as would be expected, very free from axial unsoundness and fairly free from segregation The height of the ingot is small compared with its diameter For purposes of handling in forging, a stalk must be cast on to the ingot after it has just set. The mechanical tests given by such an ingot are distinctly better than those from a normal ingot of similar weight, particularly as regards specimens cut transversely In the typical ingot discussed, with a height of 45 in and a diameter of 70 in, the typical V segregates of the normal ingot are absent, or shown only in a series of basin shaped white markings on the sulphur print In this ingot the oil burners had been concentrated on the centre of the top surface, but since then better results have been obtained by arranging the burners around the sides of the mould

AREA COMPUTING SCALE —A useful device for computing the approximate area of plane figures of irregular shape is issued by Messrs G Cussons Ltd, Technical Works, Manchester It consists of a celluloid rectangle with graduated radial markings designed to give the required area in square inches to two decimal places As a substitute for Simpson's and other computing rules it should prove very serviceable in certain circumstances, since it needs only to be laid on the paper Special scale markings have been included to ensure full accuracy in limiting cases where this might otherwise be lost The instrument is stoutly made but transparent, whilst the markings are distinct and the figures clearly legible Explicit instructions for use, and easily grasped are given in a circular accompanying the area computing scale, and a number of illustrations are included The theory of the instrument has been given by Mr R W K Edwards in the *Proceedings of the Royal Society* vol 73, and elsewhere

EFFECT OF NITROGEN PEROXIDE ON COMBUSTION —In vol 73 of the *Proceedings of the Manchester Literary and Philosophical Society* (1928–29), Prof H B Dixon and W F Higgins record further observations of the ignition temperatures of gases determined by their 'concentric tube' method whereby the influence of surfaces is practically eliminated The abnormal behaviour of ether vapour was confirmed, and a discovery of interest was the remarkable accelerative effect of small quantities of nitrogen peroxide on combustion, as shown by a considerable depression of the ignition temperatures of ether and hydrogen in air One part of nitrogen peroxide in 12,000 of air caused a depression of 30° in the value for ether in air, 1 part of nitrogen peroxide in 200 of air brought the ignition temperature of hydrogen down to 455° These observations may be correlated with the recent observation of H W Thompson and C N Hinshelwood that nitrogen peroxide in suitable small proportions accelerate the union of hydrogen and oxygen at temperatures just below ignition They emphasise also the rôle of peroxides in accelerating combustion reactions of several types

ILLUMINATION IN BUILDINGS —Article No 18 of volume 19 of the *Scientific Proceedings of the Royal Dublin Society* deals with the measurements of the ratios of the illumination at various points within buildings to the illumination from the sky at points outside, made by Drs W R G Atkins and H H Poole The measurements were made by means of photoelectric cells and galvanometer deflections, so that they involve no visual comparisons of brightness They are expressed in terms of the 'daylight factor,' that is, the ratio of the illumination of a small horizontal surface inside a room and outside where it receives light from the whole sky, but no direct sunlight The daylight factor in a well lighted dwelling room is about 1 per cent, and close to a window may be 7 per cent In an ancient church it sank to 0·2 as the mean value for about thirty different points, at some of which it was only 0 03 The authors point out that with such low factors it is not worth while to fit glass transparent to ultra violet light in windows which do not receive direct sunlight

Permian Diptera from Warner's Bay, N S.W

By Dr R J TILLYARD, F R S

OF the myriads of species of insects which swarm upon this earth, none is of such absorbing interest to mankind in general as the two winged flies grouped together in the great order Diptera This order is, by common consent, admitted to be one of the most highly specialised within the class, if not actually *the* most highly specialised of all Yet, while no un doubted fossils of the order Lepidoptera, for example, are known older than the early Tertiary, definite, though somewhat obscure, dipterous types are known from the European Lias We know, however, that the Lepidoptera must have existed for millions of years as obscure and very small types similar to *Micropteryx* and its allies, and that these in their turn had a common origin with the Caddis flies or order Trichoptera Ancient representatives of this latter order also occur so far back as the Lias, and I have previously given reasons why the common stem of the two orders Lepidoptera and Trichoptera must be regarded as having arisen from an extinct side branch of the older order of Scorpion flies or Mecoptera, which goes back, geologically, almost unchanged to the Lower Permian and probably also to the Upper Carboniferous

More recent researches into the origin of the Diptera indicate clearly two outstanding facts, (*a*) that they are, of all existing orders, the most closely allied to the Mecoptera, and (*b*) that they must have had origin from the Mecoptera by way of a type, or types, closely resembling the hypothetical common ancestor of the Lepidoptera and Trichoptera, but retaining the markedly mecopterous character of an unbranched first cubitus in the forewing, whereas this vein is always branched in the other two orders A number of forms clearly belonging to this ancestral group, which I have elsewhere called the order Paratrichop tera, but which Dr Crampton prefers to call Proto diptera, were described by me from the Upper Trias of Ipswich, Queensland (*Proc Linn Soc N S W*, p 199, 1919) Later on, through the discovery of the older insect fauna of Belmont, N S W, of Upper Permian age, these forms were linked directly with the true Mecoptera by way of the two fossil genera *Belmontia* and *Parabelmontia*, which I placed in the new order Paramecoptera (*Proc Linn Soc N S W*, p 234, 1919, and p 286, 1922)

Fossil hunting at Belmont has always been a very arduous task, because of the hardness of the rock and the extreme rarity of the fossils A good average would be about one wing for three days' hard labour! Under such conditions it never seemed likely that a full knowledge of the Upper Permian insect fauna could be obtained The late Mr John Mitchell, who discovered these beds, had always in mind the possi bility of finding an extension of them somewhere around the shores of Lake Macquarie With the aid of Mr T H Pincombe, he succeeded in exploring a number of localities with the same geological horizon, and finally they opened up the rich fauna of Warner's Bay, on the shores of the lake above mentioned

The Upper Permian of Warner's Bay has now yielded several hundred specimens, most of which still await description Apart from abundant Homoptera and two problematical remains of Odonata, the fauna is *entirely holometabolous*, consisting of the dominant order Mecoptera and the orders Paramecoptera, Neuroptera Planipennia, Protocoleoptera, and Coleop tera The extensive representation of the order Mecoptera has brought to light so many new types that it is now found advisable to include the orders Paramecoptera and Paratrichoptera as suborders of that order, by means of a very slight extension of its accepted definition *With this extension accepted*, it would be scientifically correct to state that the three orders Diptera, Trichoptera, and Lepidoptera *have been evolved from mecopterous ancestors*

The most interesting fact about the Warner's Bay Beds, as contrasted with the neighbouring Belmont Beds of the same age, is the abundance of very small insects This is particularly noticeable in the Homop tera and Mecoptera In the latter order there are large numbers of tiny, fly like Mecoptera, closely allied to the existing Australian family Nannochoristidæ Some of these are practically complete specimens, and the more slender of them appear to have had hind wings in various stages of reduction, though their habit of dying with all four wings closely folded together makes the working out of the hindwing a very difficult task

Bearing in mind the fact that four winged Para trichoptera are known to have lived in Australia right up to Upper Triassic times, while the oldest known true Diptera are Liassic, it did not seem very probable

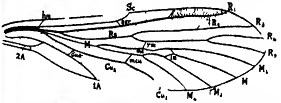

FIG 1—*Permotipula patricia* n g et sp. Forewing Length 5 mm Upper Permian of Warner's Bay, N S W Discovered by Rev A J Barrett, 1928.

that we should ever discover true Diptera at Warner's Bay But I have had the possibility in mind for some years, remembering that Protocoleoptera are found alongside true Coleoptera in the same beds, and Protodonata alongside true Odonata in the Lower Permian of Kansas Every small Mecopteron has been carefully studied in the hope of finding something more definitely dipterous than any hitherto known But, until quite recently, the search was unavailing

When I returned to Australia in October last, my friend the Rev A J Barrett, who had become interested in the Warner's Bay Beds, sent me a small parcel of fossil insects which he had found there. Looking through these, I found the distal two thirds of a small wing which seemed to me so obviously dipterous that I at once proceeded to study it in detail To my great joy I found that both obverse and reverse impressions had been saved, and that in one of these the basal portion of the wing was covered by a small piece of rock It is a risky matter to attempt to uncover hidden portions of fossils in this cherty shale; but I took the risk. A lucky stroke removed the overlying piece, and succeeded in expos ing the complete wing, with only minor damage To my astonishment, not only was this found to be truly dipterous, with an unexpectedly petiolate basal por tion, but it must also be definitely classified as Tipuloid, and distinctly more advanced than such living forms as the Tanyderidæ, which have retained the original four-branched radial sector (*Rs*)

Fig 1 shows this remarkable wing, which is just 5 mm. in length. The missing portions of the costa, apex, and posterior margin, and of the apical part of the first cubitus, are indicated by broken lines;

otherwise the wing is complete The wing is of the greatest interest, because any student of venation would certainly classify it as dipterous and nothing else, and yet *we do not know whether the insect to which it belonged had four wings or only two!* Also, it is the oldest known dipterous type of wing by many millions of years

To facilitate discussion, it would be advisable to name the wing at once At Mr Barrett's request, I name it after my wife, as *Permotipula patricia* n g et sp The wing must be classified in the superfamily Tipuloidea, in a new family Permotipulidæ characterised by the slight degree of petiolation, the short $2A$ and the elongate median cell (mc), and in a new genus *Permotipula* distinguished by the form of Sc, the positions of rm and mcu, the extreme narrowness and irregularity of mc, and the sessile origin of both median forks from that cell A full analysis of the venational characters and a comparison with known archaic forms of Diptera will be published elsewhere The figure itself is sufficient diagnosis of the species

This discovery appears to indicate that the tendency towards lengthening and narrowing of the wings, which is marked enough to have been commemorated in the very name of the ancestral order, Mecoptera, ran to two successful specialisations The first of these, the family Bittacidæ, retained all four wings, and so remains classified to day as a family within the Mecoptera The second evolutionary effort, acting on much smaller and more insignificant types allied to the Nannochoristidæ, produced the true Tipuloid Diptera, or two winged analogues of the Bittacidæ From such small and obscure forms as the one now discovered, the great order Diptera must have originated, with all its multitude of new types, just as the even greater order Lepidoptera must also have originated from small and obscure types resembling *Micropteryx* and its allies For a correct understanding of the larval forms of these two great orders, maggot and caterpillar alike, we must go back to the ancient polypod larva of the true Scorpion flies

The Department of Scientific and Industrial Research

A PERUSAL of the Report of the Department of Scientific and Industrial Research for the year 1927–28 (Cmd 3258 London H M S O), which includes a summary review of the work carried out under the various research organisations of the Department during the year, will provide the reader with abundant evidence of the wide range of the activities and responsibilities of the Department The position of the research associations formed under the ægis of the Department is discussed elsewhere in this issue (p 749) The National Physical Laboratory and the Geological Survey have been for some years under the general direction and control of the Department, and there are between forty and fifty research boards and committees, dealing with such diverse subjects as chemistry, fabrics, engineering, metallurgy, physics, radiology, building, architectural acoustics, heating and ventilation, food, forest products, fuel, atmospheric pollution, national coal resources, water pollution, adhesives, dental investigations, gas cylinders, illumination, lubrication, and X rays To attempt to give, in a reasonable allowance of space, a condensed compendium of what the report has to say on all, or even most, of these activities, is obviously impossible, and we must be content to select, more or less at random, some features of interest

There are 36 pages devoted to a summary of the main features of the work of the nineteen research associations still in receipt of grant aid from the Department The Wool Research Association has introduced this year a new woollen ring spinning frame which, it is claimed, is capable of producing two and a half times as much yarn per spindle as the standard frame, and of giving a superior yarn It is the outcome of an exhaustive analysis by the latest scientific methods of the exact functions of every part of the existing 'Standard' machine, an analysis which showed clearly the directions in which simplicity could be effected without destroying practical efficiency Reference is made to the new lead alloy introduced by the Non Ferrous Metals Research Association as a result of investigations undertaken in co-operation with the Research Department, Woolwich It has a strength, weight for weight, some 40 per cent greater than the ordinary commercial lead which is used for lead pipe, and, because of its freedom from the defect of a peculiar type of cracking, it is being used as a covering for electric cables. The remarkable, but not surprising, statement is made that "the Association has hitherto failed, in spite of many efforts, to arouse any interest in it among manufacturers of lead pipe and sheet' This is but another instance of the many that could be given to illustrate the lag between the completion of a research and the application of its results to large scale industrial practice

The report directs attention to the surprising statement in the inaugural address of the president of the Institution of Locomotive Engineers, in September 1927, that locomotive engineers have "not at their disposal any facilities for trying out experimental scientific research", and that there is no existing organisation in Great Britain which is available generally for the accurate testing of the performance and thermal efficiency of a locomotive The Advisory Council, as the result of recent conferences on this subject, foreshadows the establishment of a national organisation for locomotive research

On the subject of low temperature carbonisation the report states that "several processes are now being operated on a scale large enough to provide reliable data by which the possible limits of commercial success can be judged" A subsidiary company of the Gas Light and Coke Company, for example, is erecting plant to try out on a commercial scale the experimental retorts developed at the Fuel Research Station Other investigations, connected with fuel research, to which brief reference is made, are those on metallurgical coke, which are being carried out by the Federation of Iron and Steel Manufacturers in co operation with the Department, on the use of pulverised fuel in the mercantile marine, and on the economical use of coal

The Empire Marketing Board has provided a sum of £18,500 for the period up to Mar 31, 1929, which has enabled the Director of Food Investigation to initiate a new programme of research on the preservation and transport of fish Attention has been paid, in the first place, to those investigations likely to yield results capable of adoption by the existing fishing fleets, and, in particular, to an investigation into the possibility of landing in first rate condition an increased proportion of the fish caught "Preliminary investigations carried out during the summer of 1927 showed, rather unexpectedly, that the flesh of fish is not inherently of a highly perishable nature, but that, on the other hand, the natural rate of deterioration is profoundly affected by secondary environmental factors" Aberdeen has been selected

as the location of a research station for the fundamental researches needed

In summarising the work done and being done on cement and concrete research, attention is directed to the fact that there are two main differences between concrete and steel which are in themselves sufficient to account for the many anomalies observed by engineers when applying to concrete the standard methods of test to determine the strength of steel The first of these differences is the normal expansion and contraction of the material as the moisture in the surrounding atmosphere varies and the second is the gradual flow of concrete under load Investigations on the measurement of adhesion stresses and of stresses introduced in the steel of reinforced concrete by the shrinkage of cement have been undertaken at the Building Research Station and have already been productive of data of much importance

Coming to the Department's activities that relate to what is usually called pure science we may note that the grants for researches research workers and students for the year ended Mar 31 1928 amounted to £31 346 net The grants made under this head during 1927 28 were in number 186 and the grants refused 118 as compared with 214 and 213 respectively for the previous year The researches so assisted in the year under review include among others the work carried out by Sir William Bragg and his collaborators on the X ray examination of materials and investigations on magnetic phenomena by Dr P Kapitza and his collaborators

Age-Hardening of some Aluminium Alloys

SOME physical properties of five typical aluminium alloys containing copper magnesium silicide or both have been examined by Dr M I V Gayler and G D Preston and the results were presented at the March meeting of the Institute of Metals From this experimental work the following conclusions regarding the causes of the age hardening of such materials are reached

On prolonged annealing it is known that the precipitation of $CuAl_2$ or Mg_2Si, or both depending on the composition of the alloy occurs The changes of density which occur during ageing together with the accompanying changes in the lattice parameter suggest that a similar precipitation from the solid solution takes place during the earlier stages of this process X ray analysis shows that in addition to the change of parameter, the crystals in the aged material are in a disturbed state which is gradually relieved as the heating is continued This distortion of the space lattice is accompanied by an increase of the electrical resistance and is believed to be caused by the formation of minute particles of the precipitated compounds The precipitation of the dissolved substance from the supersaturated solution entails, first the rejection of the atoms of the dissolved metal from the lattice of the solid solution accompanied by the possible formation of molecules a process which entails a profound disturbance of the lattice In the second stage, which may follow closely upon the first and probably largely overlaps it, a coagulation of these rejected atoms or molecules takes place, resulting in the formation of minute crystallites This coagulation process, except perhaps in its earliest stages, by removing the dissolved metal from the matrix, will tend steadily to lessen the distortion of the lattice and thereby to diminish the hardness and the electrical resistance

It is interesting to note that if the age hardening is due to the precipitation of a metal, and not a compound of that metal, the hardening effect is small, for example, the iron copper alloys This would be expected on the basis of the theory outlined above, since it would cause less distortion of the lattice, no formation of molecules being required If the formation of a compound involves the combination of atoms of the solute with those of the matrix a greater distortion of the lattice will occur and the hardening be greater When however the compound is formed by the combination of two or more different solute atoms, then still greater distortion is to be expected and marked increase of hardness results Thus the ageing of an alloy with 4 5 per cent of copper due to the formation of $CuAl_2$ is relatively much less than that of one with 1 08 per cent of Mg_2Si

Although up to the present the existence of lattice distortion has been inferred on general grounds the new evidence from the X ray spectra of aged alloys provides complete confirmation and shows by the broadening of the lines that this disturbance occurs to a marked extent which varies with the degree of hardness and electrical resistivity attained at the successive stages of the process In the later stages of the ageing when coagulation has become appreciable and the precipitated substances have formed small distinct crystallites the electrical resistance begins to fall again the hardness diminishes and the lines in the X ray spectrum become less diffuse F C T

University and Educational Intelligence

CAMBRIDGE —Dr A B Appleton has been reappointed University lecturer in anatomy and Mr G F Briggs has been reappointed University lecturer in botany

Grants have been made from the Gordon Wigan Fund to Prof J E Marr Prof J Stanley Gardiner, Mr F I Brooks and Prof J Barcroft

Dr H R Dean professor of pathology in the University has been elected Master of Trinity Hall

A Syndicate was appointed in May 1928 to report on the position of mineralogy in the studies of the University This Syndicate has now reported to the University and has made the following recommendations (1) Two new departments should be created in place of the existing Department of Mineralogy, namely a Department of Crystallography and a Department of Mineralogy and Petrology (2) the Department of Mineralogy and Petrology should be closely associated with the Department of Geology, but should also work in co operation with the Department of Crystallography (3) the head of each of the new departments should be a professor and the minimum additional staff of each department should be one lecturer and one demonstrator (4) a new building should be erected for the Department of Mineralogy and Petrology adjacent to the Sedgwick Museum (5) the premises of the existing Department of Mineralogy should be assigned to the new Department of Crystallography, (6) crystallography should become a subject in Part I of the Natural Sciences Tripos but should carry a smaller maximum of marks than the existing subjects, (7) mineralogy and petrology should form part of the subject of geology in Part I of the Natural Sciences Tripos, either as an alternative to palæontology or in addition at the candidates option, and that in the latter case mineralogy and petrology together should carry the same additional maximum of marks as that allotted to crystallography, (8) that both crystallography and mineralogy and petrology should be included in Part II of the Natural Sciences Tripos, but that their relation to the other subjects, or to possible subdivisions of them, should be determined by the appropriate University bodies, (9) subject to the adoption of the above recommendations, the existing subject of

mineralogy in the Natural Sciences Tripos should be discontinued

LONDON —Presentation Day at the University was on May 8, the ceremony taking place in the Albert Hall, the Vice Chancellor, Sir Gregory Foster, presiding The report of the Principal (Dr Franklin Sibly), the last to be presented under the old constitution, records continued progress The number of candidates for all examinations attained for 1928 a record of 34,941, comparing with 11,937 in 1913 This number includes 3383 candidates for first degrees and 508 for higher degrees, a total of 3891, of whom 2357 were internal and 1534 external In the last year before the War, the numbers were 900 internal and 907 external The roll of internal students now comprises 9886 names Referring to the obligations of the Bloomsbury site, the Principal reported that four purposes had so far been approved—an administrative block, the Library, a Great Hall, and premises for the Union Society, in addition, eleven other purposes have been provisionally approved, including an Institute of Slavonic and East European Studies, towards which an offer of £35,000 £45,000 had been received and accepted from the government of Czechoslovakia, and provision for the teaching of the History of Art, for which Lord Lee of Fareham is collecting a fund

The Vice Chancellor, in welcoming the men and women who had become bachelors during the year, and those who had received higher degrees, appealed to the graduates to join Convocation and to use their voting powers when occasion arose "These things", he said, "in the past had been left to a small minority" The University has a body of 170 professors, 80 readers, and about 830 recognised teachers Next year the Union Society would have a Union House for the promotion of social life and the maintenance of their interest in University affairs Referring to the new statutes for the University, the Vice Chancellor said that the colleges and schools are now more closely federated with the University than before, and the symbols of this are the newly created Collegiate Council and the modification of the constitution of the Senate which has made it a more homogeneous body than hitherto, and the growth of the financial responsibilities has involved the creation of the University Court to deal mainly with finance

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MR F S MARVIN will be conducting a history course at Danzig in the first week of August and has secured the co-operation of several scientific workers as well as historians and those interested in international affairs, which should make the twelve lectures as useful and comprehensive as any that have preceded them in the 'Unity' series The general topic is "The World of To-day", or "Progress in Ten Years of Peace". Mr. Marvin proposes to deal with general international relations since the War, and Rear-Admiral J D Allen, an expert on armaments and naval matters, will treat of that aspect of progress. Prof Doris Mackinnon, of King's College, London, will lecture on "Where we stand in Biology", and Mr L L White (author of "Archimedes", etc) is coming from Berlin to speak on the position of the physical sciences Other aspects will not be neglected and, as Danzig is a home of internationalism, it is hoped to secure the co-operation both of German and Polish speakers and listeners on education, art, and literature The Baltic trip offers in itself great attractions to visitors, and is too little known in England Danzig, to which passages may be booked direct from London, is the best centre. Full particulars may be obtained from the honorary secretary, Mrs. Innes, 29 High Oaks Road, Welwyn Garden City, Herts.

Calendar of Patent Records

May 18, 1804 —Gas lighting has a well authenticated history before the work of Frederick Albert Winsor, whose patent for an apparatus for making gas for lighting and heating was granted on May 18, 1804, but it was Winsor who first advocated the public use of gas lighting, and its supply and distribution from a central source Pall Mall was lighted by him in 1807, and the forerunner of the Gas Light and Coke Co was formed a few years later

May 20, 1800 —An early reaping machine was that for which a patent was granted to Robert Meares on May 20, 1800 A large pair of shears is fitted to a frame mounted on wheels Long handles are fitted to the shears and by these the apparatus is propelled and the shears operated Wires are arranged to guide the fall of the crop as it is cut

May 22, 1813 —William Brunton's 'steam horse' for propelling or drawing carriages upon roads or railways by means of levers or legs worked by a steam engine and acting alternately or conjointly against the ground, was patented on May 22, 1813 The engine worked successfully on the Newbottle colliery tramline and drew coals up an incline of 1 in 36, but was eventually wrecked by an explosion

May 22, 1834 —Baron Heurteloup patented on May 22, 1834, a self priming gun in which a long tube of detonating powder was contained in the stock and was moved forward into position by each fall of the hammer The hammer cut off the fragment of the tube required and then detonated the powder In 1836 Heurteloup petitioned the Privy Council for a confirmation of the patent as he had discovered that a similar arrangement had been previously patented in France in which a straw filled with detonating powder was used, though the action was different, the gun was not self priming, and the patent had apparently never been put into practice The petition was granted and the patent confirmed

May 22, 1847 —Sydney Smith of Nottingham solved the problem of the safe application of steam power by inventing and making the first efficient steam pressure gauge, the steam acting on a flexible diaphragm connected through mechanism with the needle of a dial The patent is dated May 22, 1847

May 23, 1829 —The accordion —the intermediate between the mouth organ and the concertina—was the subject of the Austrian patent granted on May 23, 1829, to Zyrill Demian and his two sons Karl and Guido, organ makers of Vienna The patent was originally for two years only, but was extended for another three years in 1831

May 24, 1834 —The chain grate mechanical stoker was first devised by John George Bodmer, and was included with other forms of the mechanical stoker in his patent No 6616, sealed on May 24, 1834 Bodmer described in his specification apparatus of the endless chain type, but his preferred form consisted of a number of separate carriages which were intermittently pushed forward and one by one discharged at the back end, to be returned rapidly to the front and fed with fresh coal for another passage through the furnace It was left to John Juckes, seven years later, to perfect the endless-chain type and introduce it into industry

May 24, 1847 —The fish plate joint now in universal use for the rails of railways was invented by W Bridges Adams, and was patented by him and Robert Richardson on May 24, 1847 Until its adoption, rails were butt- or lap jointed together in wide chairs

Societies and Academies

LONDON

Royal Society, May 9 —**R H Fowler** and **P Kapitza** Magnetostriction and the phenomena of the Curie point Various physical consequences of Heisenberg s theory of ferro magnetism are discussed The phenomena require the interaction integral called by Heisenberg J_0 to increase with the volume of the crystal at least over a small range of value covering the normal value for iron —**C G Darwin** A collision problem in the wave mechanics In the quantum theory the motion of matter can be regarded as a wave motion but this motion is interpreted in terms of particles in order to describe what is observed In an ideal experiment of this kind depending on collisions between two free bodies, the particle like behaviour is given just as successfully by the wave theory Thus the interpretation can sometimes be postponed —**J A Gaunt** The relativistic theory of an atom with many electrons The total angular momentum of the atom suitably defined, has the same properties as in the non relativistic theory The inner and magnetic quantum numbers, and their selection rules can therefore be taken over into the new theory —**R de L Kronig** The quantum theory of dispersion in metallic conductors —**N F Mott** The interpretation of the wave equation for two electrons As required by the relativistic equation proposed by Eddington the results of the two separate experiments required to locate each electron are independent —**G I Taylor** The criterion for turbulence in curved pipes Coloured fluid is introduced through a small hole in the side of a glass helix through which water is running C M White s conclusion from resistance measurements, that a higher speed of flow is necessary to maintain turbulence in a curved pipe than in a straight one is verified —**H J Phelps** and **R A Peters** The influence of hydrogen ion concentration on the absorption of weak electrolytes by pure charcoals Hydrogen ion concentration influences adsorption upon purified charcoal of various organic acids and bases and of some amino acids in varying degrees, sometimes showing a relationship to the degree of ionisation —**R K Asundi** The third positive carbon and associated bands The third positive carbon bands, the 3*A* bands and the so called Wolter spurious bands, have been photographed A complete vibrational analysis of the three systems shows that they have the same final electronic state —**F J Wilkins** The kinetics of the oxidation of copper (1) —**C E Eddy, T H Laby**, and **A H Turner** Analysis by X ray spectroscopy —**M C Johnson** The adsorption of hydrogen on the surface of an electrodeless discharge tube —**A Elliott** The absorption band spectrum of chlorine —**H W Thompson** and **C N Hinshelwood** The influence of nitrogen peroxide on the combination of hydrogen and oxygen —**H T Flint** The first and second order equations of the quantum theory —**S Bhagavantam** The magnetic anistropy of naphthalene crystals —**A H Wilson** Perturbation theory in quantum mechanics (2) —**C G Lyons** and **E K Rideal** On the stability of unimolecular films (1, 2 and 3) —**P A M Dirac** Quantum mechanics of many electron systems —**O W Richardson** and **P M Davidson** The spectrum of H_2 The bands analogous to the parhelium line spectrum (3 and 4) —**H E Hurst** The suspension of sand in water —**D Brunt** The transfer of heat by radiation and turbulence in the lower atmosphere —**W G Bickley** Hydro dynamic forces acting on a cylinder in motion, and the idea of a ' hydrodynamic centre —**M L E Oliphant** The action of metastable atoms of helium on a metal surface —**J Hargreaves** The effect of a nuclear spin on the optical spectra —**M N Saha** and **Ramash Chandra** New methods in statistical mechanics

Linnean Society, April 18 —**G Claridge Druce** A botanical tour in Cyprus The botanical history of Cyprus is a long one Theophrastus mentions some of its products Dioscorides alludes to its Origanum oil and Drummond in 1754 was the first to record a definite endemic species *Quercus alnifolia* a second, *Onosma fruticosum* was found by Labillardière in 1787 *Putoria* and the *Cedrus* had also thus early been noted Its true scientific exploration was began by Sibthorp in 1787 accompanied by his artist Bauer the discoverer of *Pinguicula crystallina* The new species were published chiefly by Boissier T Kotschy visited the island three times between 1840 and 1862 and brought up the number of species to 1050 Mr A Lascelles (now Sir Alfred) when he was judge there and his sister Miss Lascelles made considerable collections in 1900–2 The author verified some of the earlier records and added *Lamprothamnium papulosum* J Groves a great extension in the north east —**G S Carter** and **L C Beadle** Respiratory adaptations among fishes of the swamps of the Paraguayan Chaco As previously shown, the fauna is normally exposed to great lack of oxygen The fishes may obtain a further supply of oxygen from the well oxygenated surface film of the water and the air above the water Of the twenty species collected in the swamps eight breathe air and the remainder make use of the surface film by means of accessory organs Most of the excretion of carbon dioxide is carried on in the gills but the absorption of oxygen takes place almost entirely in the accessory organ This is due to the evolution of the accessory organs for life in a medium poor in oxygen, and not for migration out of the water It is suggested that in the evolution of the vertebrates aerial respiration was evolved in waters of this type as an adaptation to lack of oxygen while the fish was purely aquatic and that this development opened the way to the later changes definitely associated with the migration

BRUSSELS

Royal Academy of Belgium, Oct 13 —**P Stroobant** The meeting of the International Astronomical Union at Leyden, July 5–13, 1928 A general account of the work done at the meeting —**D V Jonesco** A theorem of Lord Kelvin (2) —**Victor Van Straelen** The triassic crustacean decapods and the origin of a phylum of Brachyura —**Henri Fredericq** The chronaxy of the muscles of insects From the measurements given the motor muscles of the wings of the dragon fly, humble bee, and blowfly must be considered as organs of moderately rapid function This idea, which is in contradiction with accepted ideas, can be explained, with Jarolimek if it is admitted that these muscles do not act directly on the wing —**Henri Fredericq** The chronaxy of the invertebrate heart (cephalopods and decapod crustaceans) The bathmotrope action of the visceral nerves of the octopus —**J E Verschaffelt** The determination of surface tension by the method of separating discs A discussion of the theory of the method and experimental figures for water, benzene, nitrobenzene, carbon tetrachloride, and aniline —**E Delporte** Discovery and observations of minor planets at the Royal Observatory of Uccle —**Em Vincent** Observations on the layers penetrated at the No 2 pits of the Eysden coal pit, near Maaseyck —**Armand Duchesne** The influence of the thermometer mass on the measurement of a constant tem-

perature or of one varying with time Experiments are described which support the contention that the temperature of a superheated vapour or of a gas can only be measured accurately with a thermometer of negligible mass

Nov 3 —**P Stroobant** A new calculation of the flattening of Saturn —**E Delporte** Discoveries and observations of minor planets at the Royal Observatory of Belgium —**Henri Fredericq** The action of the faradisation of the nearer portions of the ganglion nerve chain of the lobster on the chronaxy of the distant portions —**Victor Van Straelen** A new prosopon from the Diois Hauterivian and the Cretaceous 'Dromiacea' in general —**D V Jonesco** A theorem of Lord Kelvin (3)

LENINGRAD

Academy of Sciences (*Comptes rendus*, 1929, No 1) —**S Kostytschew** and **V Berg** The forms of calcium compounds in vegetable tissues The bulk of calcium in vegetable tissues is in the form of salts, mainly of oxalic, phosphoric, and carbonic acids, some of it is in complex combinations with organic substances, or in the form of salts absorbed by the colloid substances of the protoplasm No difference in the forms of calcium compounds found in leaves and in the organs devoid of chlorophyl was found —**N Gutkova** A mineral of the keffekilite group from the Tertiary deposits of the Crimea —**A N Kiritshenko** Contribution to our knowledge of the genus *Aphelochirus* (Hemiptera, Naucoridae) A list of 22 species of the genus is given and their distribution indicated on a map Two new species, *A improcerus* from Manchuria and *A ussuriensis* from the Ussuri land, are described and figured —**I Efremov** Finds of stegocephals in the north east of European Russia Four distinct places where fossil remains of stegocephals are found are described in detail —**A P Filippov** Deformation of elliptic plates with supported margins —**T Ščegoleva-Barovskaja** The first representative of the family Mordellidæ (Coleoptera) from the Jurassic deposits in Turkestan A new genus and species, *Præmordella martynovi*, representing a new subfamily Præmordellinæ is described

ROME

Royal National Academy of the Lincei, Feb 3 —**G D'Achiardi** Mode of formation of mimetic groups of dachiardite This mineral, found in the geodes of one of the pegmatitic veins traversing the granite of Monte Capanne, near S Piero in Campo, Elba, was termed mimetic zeolite, from its composition and from its occurrence in apparently octagonal prisms formed by the union of eight crystalline individuals The pseudo prismatic groups have an upper funnel shaped end, either closed or open at the centre The origin of this structure is discussed —**L Petri** Behaviour of the olive under the influence of uranium radiations and of ionisation of the air The stimulating action of ionised air on the growth of the olive is neutralised by the radiations emitted by the green oxide of uranium, when these exceed in intensity a certain limiting value —**G Vitali** Bianchi's identity for Riemann's symbols in generalised absolute calculus —**A Signorini** Electrostatic interpretation of the Kutta-Joukowski theorem —**L Fantappié** Functional operators and calculation of infinite matrices in the quantum theory (2) By means of the notion of a symmetrical or hemisymmetrical functional product and, in general, of the notions of the theory of analytical functionals, it is possible not only to replace all the symbolic formations (mostly divergent series) used in the calculus of matrices due to Heisenberg, Born, and Jordan, by so many integral formations of well defined significance, but also to reduce the whole matrix calculus to the calculus of symmetrical composition of the functions of two variables co ordinated to the matrices themselves —**A De Mira Fernandes** Superficial transports —**Silvia Martis in Biddau** Investigation of a rational expression for the powers of a matrix of the third order —**Ines Saciotto** Riemann symbols in generalised absolute differential calculus —**B Colombo** Certain theorems regarding the generalised transformations of Darboux —**A Carrelli** Broadening of bands by resonance (1) The causes for the broadening of spectral lines are numerous When, for example, the concentration of sodium atoms is diminished, the effect of resonance becomes annulled, but the pressure or Stark effect begins to preponderate, this effect being proportional, not to the number of atoms of the same kind, but to the total number of atoms or ions of any kind present in the flame Moreover, when the concentration is extremely small, the line, although having zero breadth from the Holtzmark effect or the effect of pressure, has a finite breadth by auto extinction or by the Doppler effect, and hence there should be a zone of values for the concentration in which anomalies in behaviour foreseen by Holtzmark become apparent Such a zone may be readily realised experimentally —**M Amadori** Condensation products of glucose and *p* anisidine Like *p* phenetidine, *p* anisidine condenses with glucose, giving two products, one, melting at 86°, having a glucosidic constitution, and the other, melting at 140°, the constitution of a Schiff's base —**G Malquori** Conductivity of mixed solutions of lead and ammonium nitrates The formation of complex compounds, assumed to be a probable cause of the solubility relations of solutions containing lead and ammonium nitrates, is confirmed by a study of the electrical conductivities of such solutions —**A Tulli** Chemical analysis of a mummy contribution to the study of mummification Examination of a mummy from the Vatican Museum which, although bearing an inscription indicating it to be that of a lady of noble birth, was that of a man, points to the use of natural balsams in the mummifying process —**Maria Bergamaschi** Absorption of carbon dioxide by means of roots, and its utilisation in chlorophyllic synthesis The results of experiments on maize and other plants show that plants grown in an atmosphere absolutely devoid of carbon dioxide form starch in their leaves by utilising the carbon dioxide absorbed by their roots from the soil or from the nutrient solution surrounding the roots Plants grown in this way from seeds contain a greater amount of carbon than the seeds themselves, and are, therefore, able to 'organicise' carbon dioxide absorbed through the roots The objection that, in such cases, the organic substance is formed entirely at the expense of the carbon dioxide furnished by respiration is thus refuted These results are of both physiological and practical importance, and indicate the value of supplying carbon dioxide to the roots as well as to the leaves —**G Quagliariello** Investigations on the mechanism of lymph formation The differences in chemical constitution and in chemico physical properties between lymph and plasma may be explained to some extent by assuming that, between the two liquids separated by a membrane far more permeable to electrolytes than to colloids, there is a tendency to the establishment of a membrane equilibrium It is not, however, contended that the relationship between blood and lymph is completely represented by a simple system of this kind, as it is recognised that lymph is formed, not only from the blood but also from the tissues, which may be able to withdraw from the lymph one element in preference to another

Official Publications Received

British

Air Ministry Aeronautical Research Committee Reports and Memoranda No. 1168 (Ae 332) Experiments on a Model of the Airship R 101 By Dr R. Jones and A H Bell (T 2804.) Pp 27+7 plates (London H M Stationery Office) 1s 3d net.

Cambridge Natural History Society Fauna List No 2 The Spiders of Cambridgeshire (including Harvest Spiders and Pseudoscorpions). By W S Bristowe Pp 25 (Cambridge)

Biological Reviews and Biological Proceedings of the Cambridge Philosophical Society Edited by H Munro Fox Vol 4 No 2 April Pp 103 208 (Cambridge At the University Press.) 12s 6d net

Hull Museum Publications No 155 Record of Additions Edited by T Sheppard Pp. 24+8 plates No 156 Oil Seed Crushing By T Sheppard (Commercial Museum Handbooks, No. 8) Pp 10+4 plates No 157 Record of Additions Edited by T Sheppard. Pp 50 (Hull)

Annual Report of the Council of the Yorkshire Philosophical Society for the Year 1928 presented to the Annual Meeting February 11th 1929 Pp 41+13 (York)

Commonwealth of Australia Council for Scientific and Industrial Research Bulletin No 41 Studies concerning the so called Bitter Pit of Apples in Australia, with special reference to the variety Cleopatra By W M Carne H A. Pittman and H G Elliot Pp. 101 (Melbourne H J Green)

Air Ministry Aeronautical Research Committee Reports and Memoranda No 1196 Report on Progress during 1927 28 in calculation of Flow of Compressible Fluid and Suggestions for Further Work By Prof G I Taylor (T 2654) Pp 18+3 plates (London H M Stationery Office) 1s net

Memoirs of the Asiatic Society of Bengal Vol 9 No 5 Geographic and Oceanographic Research in Indian Waters. Part 5 Temperature and Salinity of the Surface Waters of the Bay of Bengal and Andaman Sea with references to the Laccadive Sea. By Lieut -Col R B Seymour Sewell Pp. 205 355 (Calcutta.) 5 10 rupees.

Publications of the South African Institute for Medical Research No 22 A Mosquito Survey of certain Parts of South Africa with special reference to the Carriers of Malaria and their Control (Part 2). By Dr Alexander Ingram and Botha de Meillon Pp 83 170+10 plates (Johannesburg)

The Quarterly Journal of the Geological Society Vol 85 Part 1 No 337 April 19th Pp xlviii+108+10 plates. (London Longmans Green and Co Ltd) 7s 6d

Foreign

Scientific Papers of the Institute of Physical and Chemical Research No 182 Researches on the Piston Ring By Keikiti Ebihara. Pp. 107 185 1 20 yen No 183 The X Ray Diffraction Haloes in the Aqueous Solutions of Electrolytes By Hikoichi Shiba and Tokunosuke Watanabe Pp. 187 192 20 sen No. 184 A Study of the Helium Band Spectrum By Sunao Imanishi Pp. 193 209 25 sen No 185 Non-Consumption of Vitamin B by growing Chicken Sarcoma By Waro Nakahara and Eiichi Somekawa Pp 211 220 25 sen (Tōkyō Iwanami Shoten)

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol 81 Studies in Malayan Blattidae (Orthoptera). By Morgan Hebard Pp. 109+6 plates (Philadelphia.)

Bulletin of the American Museum of Natural History Vol 58 Art 6 The Parasitic Worms collected by The American Museum of Natural History Expedition to the Belgian Congo 1909–1914 By Horace W Stunkard Pp 233-289 (New York City)

The Danish *Dana* Expeditions 1920–1922 in the North Atlantic and the Gulf of Panama Oceanographical Reports edited by the *Dana* Committee. No. 3 Contribution to the Hydrography of the North Atlantic the *Dana* Expedition 1921 22 By J P Jacobsen Pp. 98 (Copenhagen Gyldendalske Boghandel London Wheldon and Wesley Ltd.) 12s.

Smithsonian Institution United States National Museum Bulletin 100 Contributions to the Biology of the Philippine Archipelago and adjacent Regions The Fishes of the Series Capriformes, Ephippiformes and Squamipennes collected by the United States Bureau of Fisheries Steamer *Albatross*, chiefly in Philippine Seas and adjacent Waters By Henry W Fowler and Barton A. Bean Pp. xi+352. (Washington D C Government Printing Office.) 60 cents.

Catalogues.

Nickel Cast Iron Series B, No 5 Nickel Cast Iron By Prof D Hanson Pp. 12 (London The Bureau of Information on Nickel, Ltd.)

Chemical Apparatus Laboratory Apparatus, Machinery and Equipment for all branches of Educational Research and Industrial Chemistry Chemicals and Reagents, Scientific and Technical Books. (Catalogue No 12A) Pp xvi+990. Microid Pyrometers. (Catalogue No 20T) Pp 44 (London and Glasgow Griffin and Tatlock Ltd)

Diary of Societies.

FRIDAY May 17

Royal Sanitary Institute (at Town Hall Devizes), at 5.30 —R. T Rhodes and others Discussion on The Milk and Dairies Order 1926. —L. B. Densham and others Discussion on Meat Inspection.

Royal Photographic Society (Pictorial Group, Practical Meeting), at 7

Royal Society of Medicine (Obstetrics and Gynaecology Section) (Annual General Meeting), at 8.—Dr H. R. Spencer A Straight Rod Pelvimeter —G I Strachan Some Contraindications to Radiotherapy in Carcinoma of the Uterus.—V Bonney Results of the Surgical Treatment of Carcinoma of the Uterus.

SATURDAY May 18.

Royal Sanitary Institute (at Town Hall Devizes), at 10 A.M.—H R. Hooper and others Discussion on Some Aspects of Local Government on Air Water and Sewerage —A. W Jakeway and others Discussion on The Devizes Sewage Works and Small Type Refuse Destructor

MONDAY May 20.

Cambridge Philosophical Society (in Cavendish Laboratory), at 4 30 —Dr H. Jeffreys On the Transport of Sediments by Streams —Dr B F J Schonland A New Electroscope —J Hargreaves (a) The Dispersion Electrons in the One Electron Problem (b) Some Calculations Relevant to the Quantum Defect in the Extended Ritz Formula. —S E A Landale An Analysis of Triode Valve Rectification —*Papers to be communicated by title only* —J A. Chalmers An Approximate Method of Determining the High Velocity Limits of Continuous β ray Spectra —L Roth Jacobian Surfaces of Quadrics in Four Dimensions —L Rosenhead Systems of Double Rows of Line Vortices in a Channel of Finite Breadth where the Axis of the Row is Parallel to the Axis of the Channel —J R Wilton On Ramanujan's Arithmetical Function $\Sigma_{r,s}(n)$.—P L Srivastava On the Phragmén Lindelöf Principle —Dr A C Dixon The Second Mean Value Theorem in the Integral Calculus —R A. Frazer A Proof of Miquel's Theorem by Involutions in the Argand Diagram

WEDNESDAY May 22

Royal Society of Medicine (Comparative Medicine Section) at 5 —Annual General Meeting

Eugenics Society (at Linnean Society) at 8 —Dr R A Fisher Prof T E Gregory and others Discussion on Are Family Allowances Eugenic in Effect?

Institution of Water Engineers (at Birmingham).

THURSDAY May 23

Imperial College Chemical Society (in Main Chemistry Lecture Theatre Royal College of Science), at 5 —Prof R Robinson The Chemistry of the Indole Group

Institute of Pathology and Research (St Mary's Hospital), at 5 —Prof W W C Topley The Natural Acquirement of Immunity

Royal Aeronautical Society (at Royal Society of Arts), at 6 30.—F A Foord Lubrication of Aircraft Engines.

Faraday Society (Annual General Meeting) (at Chemical Society), at 7 45 —At 8 —J C Hudson Third (Experimental) Report to the Atmospheric Corrosion Research Committee of the British Non Ferrous Metals Research Association

Royal Society of Medicine (Urology Section), at 8 30 —Annual General Meeting

Institution of Water Engineers (at Birmingham).

FRIDAY May 24

Linnean Society of London (Anniversary Meeting), at 3 —Presidential Address and Presentation of Linnean Gold Medal to Prof H de Vries

Royal Society of Medicine (Disease in Children Section) (Annual General Meeting) at 5 —Dr F J Poynton Some Phases in English Pediatrics as viewed by a General Physician

Physical Society (at Imperial College of Science), at 5 —Dr Ezer Griffiths A Hygrometer for Use in Timber Seasoning Kilns —Dr J H Vincent Experiments on Magneto-strictive Oscillations at Radio Frequencies.

Royal Institution of Great Britain at 9 —F J Rennell Rodd The Tuareg Tribes of Central Sahara

Institute of Chemistry (Edinburgh and East of Scotland and Glasgow Sections) (jointly with Society of Chemical Industry—Edinburgh and East of Scotland and Glasgow Sections) (at Glasgow) —Prof G G Henderson Recent Research in the Terpene Series

Institution of Water Engineers (at Birmingham).

SATURDAY May 25.

Institute of Chemistry (Edinburgh and East of Scotland Section) (jointly with Society of Chemical Industry—Edinburgh and East of Scotland and Glasgow Sections) (at Glasgow)

CONFERENCE.

May 18 to 21

Association of Teachers in Technical Institutions (at Liverpool).

PUBLIC LECTURES.

TUESDAY May 21

University College at 5.30 —Dr R. Flower Life History and Folk lore of a Kerry Island. (Succeeding Lectures on May 28, June 4 and 11.)

THURSDAY May 23

University College, at 2.30.—Sir Flinders Petrie Recent Discoveries at Beth Peleth, Palestine. (Lecture to be repeated on May 31 at 5 30, and on June 1 at 3.)

University of Birmingham, at 4.—Dr H C Cameron Some Types of Septic Infection in the Newly born (Ingleby Lectures). (Succeeding Lecture on May 30.)

FRIDAY May 24.

Birkbeck College, at 5.30.—Prof. S. de Geer Sweden and the North of Europe. (Succeeding Lectures on May 28 and 30)

SATURDAY, MAY 25, 1929

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No. 3108, VOL 123]

Competition and Progressive Industry

COMPETITION in a general sense is easily defined, and the dictionaries are fairly clear and consistent in their meaning In the strictly economic sense also there has hitherto been little difficulty The American economist Walker, for example, is very precise and definite in his description of the essential nature of competition Competition, he says, signifies the operation of individual self interest among the buyers and sellers of any article in any market It implies that each man is acting for himself solely, in exchange, to get the most he can from others, and to give the least he must himself Competition is opposed to combination in any form, to custom, and to sentiment, even though these, especially the two latter, in actual business have always played a part

No one to day believes, however, in the possibility of pure and unalloyed competition, wholly unrestrained and unregulated Not only does it exist, of itself, in many varied forms and manifestations, but also it has been profoundly affected by the introduction of ethical and moral considerations, many of which have acquired the force and status of law Moreover, other great forces have sprung into existence and rapidly developed of late years, such as co operation and combination, the formation of trusts and cartels and of vast international conglomerations, whereby the original conception of competition has either been pushed entirely into the background or has been transformed beyond recognition The question is thus raised in an acute form What is the real essence and purpose of competition in industry to day? What part, if any, does it seem destined to play in the future? Can it be reconciled and fit in with the new changes and new forces, or is it being transformed out of existence?

Much confusion of thought on these questions arises from the divergent views held in regard to industry itself and its proper place in the scheme of things The socialist attitude, for example, towards competition will be very different from that of the individualist, and again, those who disbelieve in industrialism altogether will certainly entertain the utmost loathing for competition, the most powerful instrument of progress It is therefore necessary, at the outset, to make a philosophical distinction, and decide whether we believe in progress or not, whether we have a profound faith in the Baconian philosophy of 'fruit' or in the Diogenic doctrine of the tub, with its reduction

of wants and satisfactions to a minimum It is not necessary at this time to deal with the larger question of progress and its would be philosophical critics, or to frame an elaborate apologetic of modern industry It will be taken for granted that progress, with all its errors and blind gropings and possibly mistaken ideals, is desirable and indeed inevitable, that it is not necessarily soul deadening materialism, but can be made subservient to the highest intellectual and moral interests and activities of mankind It will be shown that competition can play a vital and increasingly nobler part in that progress

In regard to the socialist attitude, it is of interest to quote J Stuart Mill's incisive condemnation thereof—and he of all men, cannot be charged with undue harshness to the socialists He says

I utterly dissent from the most conspicuous and vehement part of their teaching, their declamations against competition With moral conceptions in many respects far ahead of the existing arrangements of society, they have in general very confused and erroneous notions of its actual working, and one of their greatest errors, as I conceive, is to charge upon competition all the economical evils which at present exist They forget that wherever competition is not, monopoly is, and that monopoly in all its forms is the taxation of the industrious for the support of indolence, if not of plunder Instead of looking upon competition as the baneful and anti social principle which it is held to be by the generality of Socialists, I conceive that, even in the present state of society and industry, every restriction of it is an evil, and every extension of it, even if for the time injuriously affecting some class of labourers, is always an ultimate good To be protected against competition is to be protected in idleness, in mental dullness, to be saved the necessity of being as active and intelligent as other people"

This no doubt is far too sweeping, and, while showing up the error of the socialist view, commits serious blunders of its own Every restriction of competition is not of course necessarily an evil nor is every extension thereof an ultimate good nor is every form of monopoly always evil In fact, neither Mill nor the socialists have found the real truth Both competition and monopoly require proper regulation and control, when both may be highly beneficial It is not indeed by any means certain that unrestrained monopoly is a greater social evil than unrestrained competition, though strangely enough, and through a most remarkable form of mental aberration, free competition has been held by some, for example, the framers of American anti-trust legislation, to be sacrosanct and above reproach, whilst monopoly has been anathematised as everything that is bad Under the latter misguided view the whole basis of patent law, among other things, is thoroughly wrong and unsound But a full discussion of monopoly and all its implications must be deferred

In its natural and original sense competition means the struggle for existence, issuing in the survival of the fittest It dominates biology and the theory of evolution, and when Herbert Spencer applied evolutionary doctrine to social phenomena it was taken over almost in its entirety—with all its crudeness and cruelty—by the economists, at least for a time Huxley seems to have been among the first to see that this was going much too far He realised the necessary checks to the full force of competition which must be imposed by the social framework within which it acts Social progress", says Huxley, means a checking of the cosmic process [of ruthless competition and struggle] at every step, and the substitution for it of another which may be called the ethical process, the end of which is not the survival of those who may happen to be the fittest in respect of all the conditions which exist (environment), but of those who are ethically the best" Thus an ethical aspect was introduced, and thus incidentally we see also that the question, Who are fittest to survive? to which reference will be made later, is involved

Prof Gide's definition is When each individual is at liberty to take the action he considers the most advantageous for himself, whether as regards the choice of an employment or the disposal of his goods, we are living under the regime of competition But this takes too much for granted and lacks precision, for, strictly speaking, robbery with violence, or piracy, or fraud and cunning, are not excluded It is therefore clear that competition must keep within the law, most of which—written and unwritten—can be summed up in the good old sporting phrase, "Play the game, and take no mean advantage of a rival" Moreover, we no longer believe in the blind uncontrolled evolution of society We believe it is possible to set definite aims before us, for example, in regard to race improvement and the ultimate attainment of the highest type of manhood No longer is everything to be sacrificed to the accumulation of wealth, we place man first, and with this profound change in aim there is a change in the rules of competition Slavery has been abolished, piracy does not now figure in honourable competition, the labour of young children is condemned, the hours of work of adult men and women have been reduced. The

cruelties of the cosmic struggle are being constantly mollified by rising ethical and moral standards What may be called the 'plane of competition' has been raised to loftier heights, and much has been left behind and below in the process Piracy and all that it means, the arbitrament of force and cunning, has fallen outside of and below that rising plane, and has been replaced by other mighty forces working strongly for social betterment Of these forces, co operation, *or the enlargement of the competitive group*, is among the greatest

At first sight it would appear that increasing co operation means decreasing competition, but this is probably a superficial misconception There has been co-operation from the beginnings of things Even among animals, with the struggle for existence at its keenest, there is, nevertheless, a certain amount of mutual agreement and help among the members of a group or community What has happened in modern times, with growing co-operation, is a difference in degree rather than in kind the competitive group has become larger, and new groups have been formed This coalescing into groups, political, economic, scientific, and the like, is one of the most characteristic phenomena of modern society, and its reaction on competition is of profound interest One of the results so far is an infinite variety of competitive groups, and although the competition, as between different groups, may be keener than ever, it is also cleaner, and the effect on an individual is softened and modified, not only by association with others in the group, but also by a rising tide of sympathy, benevolence, and public humanitarianism expressed both through law and custom, and the group is thereby strengthened Darwin realised this clearly enough He says

"Animals endowed with the social instincts take pleasure in one another's company, warn one another of danger, defend and aid one another in many ways These instincts do not extend to all the individuals of the species, but only to those of the same community As they are highly beneficial to the species they have probably been acquired through natural selection"

In human affairs, however, the groups are getting larger, are reaching out rapidly to international dimensions This is a stern fact of our times, and we see not as yet clearly whither it will lead us, or how it will end It is the greatest and most perplexing problem of the age But one thing at least seems perfectly clear. If we take for examination any one particular group, say, a trade union of workers in any one industry, do we not see that the grand idea of co operation is not necessarily antagonistic to or mutually destructive of competition, that competition, in one very important direction, may be retained in full force, namely, *in the terms of admission to the group*? Membership of a group in most professions, and formerly in the old trade guilds, is or was a guarantee of a certain standard of workmanship and character It is surely in the best and highest interests of a group or union to maintain a high standard It would still be possible to permit of several grades within the group, and the good workman should not be penalised and brought down to the level of the inferior, or the latter unduly bolstered up to heights beyond his deserts As we have already seen, even J Stuart Mill would allow no weak sentiment, no excess of humanitarian zeal, to thwart the exercise of this salutary principle

In regard to another important manifestation of industrial grouping, namely, that of the trust and international combine, and its effect on competition, it is only possible to refer here very briefly to one or two points It is now generally agreed that complete monopoly is very difficult of achievement, and even if achieved it must be subject to control by the State But the form of control, as the Federal Trade Commission of the U S A has found, presents great practical difficulties The combine itself, however, and also the trade association, is finding that, in its own best interests, it must put service to the public before exploitation, and that control should be exercised so far as possible from within rather than imposed from without Hence it is that there is now much talk of ethical rules and standards by trade associations, especially in the U S A, and that unfair methods adopted by any member should justify the expulsion of that member from the group Here again the competitive principle may be applied in the selection of the right men to control the destinies of the group, and perhaps also by the imposition of certain conditions and standards of membership This also applies to the co operative societies in all their manifold forms

It is being increasingly realised, even by the most powerful combine, that trade is healthiest and most flourishing when built up, not on selfish aggrandisement but on service, good quality, and moderate prices, and those groups are 'fittest to survive' who take their stand on these adamantine foundations Competition of the right kind is still the mainspring of progress, but it is constantly rising to higher levels, and implies worthy struggle for the things that matter

History of Biology

The History of Biology a Survey By Erik Nordenskiöld Translated from the Swedish by Leonard Bucknall Eyre Pp xii + 629 + xv + 16 plates (London Kegan Paul and Co, Ltd, 1929) 25s net

A SYSTEMATIC historical account of the development of biology has long been a desideratum, and, as Dr Raymond Pearl says of the German edition, the blank has been admirably filled by Erik Nordenskiöld" The author is a trained original worker in zoology, whose experiences, among others, ranged over the shores of the North Sea at the St Andrews Marine Laboratory, and whose zeal, erudition, and scientific accomplishments enabled him to deal with the subject no less adequately than his facile pen portrayed

The task undertaken by the author was one of no ordinary magnitude, involving infinite labour and careful judgment in addition to an extensive and sound knowledge of biology, so that he was enabled to grasp the trend of the labours and epitomise the main facts or theories of the writers from various points of view, as well as bestow sound criticism The work is divided into four heads (1) Biology in classical antiquity, (2) biology during the Renaissance, (3) biology in the seventeenth and eighteenth centuries, (4) biology during the first half of the nineteenth century The author centres in Babylon, that ancient home of civilisation, the early acquaintance with the subject from contact with animals—though Oriental wisdom was largely composed of the mystical and the magical—matured and developed by a powerful priesthood The Egyptian and Israelitic, the Hindu and Chinese conceptions followed Amongst the earliest scientists of Greece, again, were the Ionian philosophers, some of whom, like Thales, regarded water as the cause of all things—even the earth coming into being from its condensation, whilst living forces were evolved by a kind of primordial procreation in the mud The influence of the philosopher Pythagoras on scientific development was great, as also was that of Plato, who laid the foundation of biological systematisation The early medical writings of Greeks, such as those of Hippocrates (the Great) "on air, water, and places", and the belief that the body was composed of four elements—fire, air, water, and earth—closed the period of natural philosophers' speculations Yet about this time human osteology was studied so far as the skeleton, the brain, nervous system, the eye, ear, and the urogenital system

The advent of Aristotle, one of Plato's students, and the greatest biologist of antiquity, meets with ample treatment He upheld the domination of form, that is, of the spirit, over matter, and of motion as the origin of all things As a prolific writer on biology, metaphysics, statesmanship, and art, his influence was great He interested himself in marine as well as land animals, indeed, the former are better represented in his works than the latter His evolution was a product of divine wisdom, whereas that of Democritus was the dominion of necessity

The anatomists of Alexandria and those of Arabia next come under review, and thereafter Pliny and Galen are dealt with, as well as the condition of science in the Middle Ages Moreover, the institution of universities in the twelfth century as growths from the cathedral schools was a noteworthy development As the pupils at these schools increased in number the teachers combined to form what was termed a *Universitas magistrorum*, and thus the Universities of Paris, Oxford, and Leipzig were founded

During the latter part of the Middle Ages biology was often prominent, though the writings of Aristotle were chiefly followed, and a compilation of the literary material of the past was common One man, however, resolutely fought the schoolmen and their antiquated views, this was Roger Bacon, and he led the way to the future Renaissance Nature was now to be studied unfettered by Church dogmas and scholastic systems, and thus biology reached results far beyond those of Aristotle or Galen Ushered in by the "Novum Organum" of Francis Bacon, a number of distinguished authors in zoography, anatomy, medical science (including dissection), such as Vesalius and Fabricius, led up to the epoch making discovery by Harvey of the circulation of the blood, which ousted from the field all the previous erroneous views

The end of the seventeenth and the eighteenth century was marked by the appearance of mechanical Nature-systems such as those of Descartes, Hobbes, and Spinoza, yet Boyle, the first modern chemist, and Newton, the illustrious discoverer in mathematics and optics, flourished The end of the seventeenth century saw the discovery of the lymphatic system and notable advances in anatomy and physiology, the author consistently giving to each discoverer a due meed of praise—the result of his own industry in master-

ing their researches Names familiar to every student of biology, such as Leeuwenhoek and Malpighi, are crowded in this great period in the history of anatomy The beginning of the eighteenth century saw a further series of able workers, commencing with Sydenham and Hoffman (the latter holding that matter and motion formed the foundations of existence), to Swedenborg's investigations of the brain

Before the advent of Linnæus, attempts to classify plants had been made by Cesalpinus, Tournefort, and Ray, the "Historia plantarum generalis" of the latter forming an important treatise He also wrote two zoological works of note, and, besides his later publications, which were extensive, he made advances in realising the difference between species and genus, and he had a keen eye for natural groups

In the treatment of Linnæus the author's skill in epitomising the salient features of a distinguished man's career are conspicuous He shows that Linnæus possessed an extraordinary capacity for observing natural objects and surroundings, and such he used in the various important works, for example, the 'Systema Naturæ" His plant system and his binomial nomenclature are amongst his most successful performances The account of Buffon and his friend Daubenton follows, the theoretical ideas of the former and the anatomy of the latter bearing important fruits

The advance of natural science in the eighteenth century by Réamur, the experimental and speculative biology of Haller, Bonnet's parthenogenesis, Wolff's generation theory and epigenesis and other noteworthy features of the period are fully dealt with Descriptive and comparative anatomy by Albinus and Camper, as well as the labours and the museum of John Hunter, carry us to Pallas, zoologist, botanist, and traveller—all receiving careful treatment Modern chemistry and its influence on biology is then considered, whilst critical philosophy and romantic conceptions of Nature follow Kant, Fichte, Goethe and his metamorphosis of plants are all ably criticised, as also Oken's natural philosophy, Erasmus Darwin and his "Zoonomia", E G St Hilaire and his fundamental type of vertebrates

We now reach biology in the first half of the nineteenth century—a period in which a galaxy of eminent comparative anatomists occur—from Vicq d'Azyr to De Blainville, two names being especially familiar, namely, Lamarck and Cuvier, though all are noteworthy Lamarck, from his numerous works, is looked on as a pioneer of modern biology His life theory is motion, and he asserted that spontaneous generation goes on incessantly under heat, light, and electricity Cuvier's chief investigations were in the vertebrates—both living and extinct To the last he held to the immutability of species and to the incomparability of types Bichat and De Blainville both accomplished important work Embryology received great advances, especially experimentally, workers in microscopy and cytology were numerous, others in the field of geology also made great strides Then came Darwin, whose sketch gives another example of the author's method and fairness to the great naturalist, his supporters and opponents His theory early found a home in Germany, championed by Gegenbauer and Haeckel, and his influence compelled a whole generation everywhere to follow his line of thought

The discovery of microbes by Koch, the work of Anton Dohrn at Naples, the researches on heredity and descent, the advance of experimental biology, and distinguished workers who followed Mendel, or extended biochemistry, conclude this remarkable book with its thirty two portraits of ancient and modern biologists The author, indeed, has accomplished a task almost as formidable as that of his distinguished uncle in surmounting the North East Passage W C M

Medieval Devil Worship

The History of the Devil the Horned God of the West By R Lowe Thompson Pp xiv + 172 + 8 plates (London Kegan Paul and Co, Ltd, 1929) 7s 6d net

It is interesting as well as instructive to reflect that, even at the beginning of the present century, it was not an uncommon thing to find the religious practices of primitive peoples described in the pages of missionary magazines as 'devil worship', and the term is still frequently ascribed in popular language to the Voodoo rites of Haiti The missionary of to day will not be responsible for a like crudity, but his predecessors in stigmatising what was outside the pale as the province of the Adversary, was following the precedent of the early Church For the early Christians the devil was a very real problem Not only had eastern religion and philosophy made familiar the opposition of the good and evil principles, the Church was constantly confronted with the problem of backsliding, more often than not involved in the performance of civic duties Further, the Christians were the more harsh in their condemnation because they themselves in

their attitude to the world of spirits were not far removed from the pagans, even though they worshipped other gods

Therefore heretics, whatever their heresy, were ensnared by the devil, Manichees, gnostics, and the like were not merely theologically in error, they were actively worshippers of the evil one, their assemblies orgies of debauchery—scenes such as Walter Mapes describes writing of the Patarini, when indeed he seems to be attributing to these heretics nothing more than an inversion of the Christian agape or love feast Most of the accusations of blasphemy brought against the witches show the same lack of imagination and were formulated by a simple inversion in every detail of the practice of the Church Whether or not these accusations had any foundation in fact, the practices thus recorded are not pagan ritual unless the sexual licence is regarded as a fertility rite The sacrificial meal in the circumstances points no more in one direction than the other In fact, if the Bull of Innocent VIII be taken as defining the medieval witch, it appears that outside certain popular conception of magical powers—blasting crops, casting spells on cattle and persons, and the like, ideas common to all primitive peoples—the distinguishing mark of the witch is the compact with the devil This is purely a theological conception which can be traced back to the early days of the Church So far there is support for those who hold that witchcraft was a form of heresy which threatened the existence of the Church and therefore exonerates it from the odium of a persecution which grew out of a baseless superstition

To the average modern the medieval mind is a closed book Of all its manifestations the witchcraft persecutions are the most difficult to understand Any investigation or theory which can help to bridge the gap between modern times and the Middle Ages deserves to be weighed before it is rejected It is for this reason that Miss Murray's book on the witch cult in Western Europe and now Mr Thomson's book on the devil are welcome They offer theories which, to an anthropologist at least, come within measurable distance of an intelligible formula, of a cause for action which, if not such as moves the modern educated mind, is at least intelligible at a certain stage of culture Mr Thomson, with Miss Murray, believes that witchcraft was a system of religious worship with a regular ritual, meaningless in its medieval context, which had survived from a primitive fertility cult Of this the central figure, the devil, was in earlier times the Celtic horned god Cernunnos, a figure in turn derived from the masked figures of palæolithic art, and in particular the well known *sorcier* of the Trois Frères cavern at Les Eyzies The horned tailed figure of the last named must inevitably recall the horned medieval devil

Mr Thomson supports this view by a wealth of argument, but there are difficulties For one thing, there is a lengthy gap between palæolithic times and the Cernunnos of the Iron Age It is difficult to believe in a popular cult entirely submerged for that length of time Further, is Cernunnos himself indubitably indigenous to Western Europe? The cult of the goat in connexion with witchcraft did not reach Britain Is that because it had a Mediterranean origin and distribution only? There is, however, this much to be said for the view, that there was something of the nature of a popular cult at the back of witchcraft It is difficult to explain away the evidence in the English trials, and some of the Scottish and Continental evidence, on any other view The actual words of the confessions seem to convey the convictions of the speakers and seem to be too consistent *inter se* to be hallucinations If it were not for this the whole witchcraft persecution and the devil cult might be more properly regarded as an inglorious, if logical, climax of the whole body of previous Christian theology and ecclesiastical history

Mr Thomson follows the lead of the devil along many entertaining by paths Among his modern instances his account of the recent case of the Abbé Desnoyers, near Melun, would have gained in interest had he told the whole story This remarkable case was really a battle between two cults In this, as in the previous case six years before, the original offence which gave rise to the accusation of witchcraft was not in the details given in the courts which Mr Thomson quotes, but in the fact that an image of the Madonna which shed real tears and belonged to Mme Mesmin, on whose behalf the Abbé was attacked, had been made by him to cease to function

Neurology and Psychology.

The Matrix of the Mind By Prof Frederic Wood Jones and Prof Stanley D Porteous Pp xi + 457 (Honolulu, T H University Press Association, London Edward Arnold and Co, 1928) 21*s* net

THE two authors of this unusual book, one an anatomist, one a psychologist, set out to blend the "subject matter and viewpoints of two sciences neurology and psychology". As they point

out in the preface, the ordinary text book of psychology makes little or no attempt to relate the structure of the brain to its function Neurology, however, comprises more than the facts of the structure of nervous system, and the author of the first portion of the book (that dealing with structure) has produced a most readable general review of comparative neurology in both its structural and functional aspects The evolution of the neopallium, the portion of the brain believed by the morphologist to be the cortical structure concerned with the complex correlation of the different sensations, and therefore probably the organ of mind, is traced through the vicissitudes in the phylogenetic development of the sense organs The reflection of animal behaviour upon the sense organs, and consequently upon their nervous connexions, is illustrated by many particularly entertaining and original accounts of the behaviour of some of the Australian fauna in relation to the structure of their brains

This means of approach to the study of mind reveals, however, that the morphologist has to restrict himself to wide generalisations in the relation of behaviour to structure It is evident that, just as the morphologist is unable to deduce from the structure of the nervous system of a certain frog that it will react to the sound of a splash by diving into water, so the psychologist cannot, at present, base any but the most gross errors in mental make up on any structural alteration Nevertheless, since the evolution of behaviour does carry with it recognisable structural changes, there is presumably some structural basis, as yet unknown, underlying minor changes in behaviour in any one particular species, and it would therefore seem profitable to make the utmost use of such structural alteration as can be found in cases of human psychological abnormality

The second portion of the book (dealing with the psychological aspect) is disappointing from this point of view, for little attempt is made to enlarge upon the behaviouristic significance of the morphology of the sense organs and the neopallium in connexion with psychology and psycho-pathology Instead, the working of the mind, with the usual discussion of sensation, attention, and behaviour, in terms of the outworn physiological principles of ‘facilitation’ and ‘synaptic resistance’, is here further involved in new functional theorems such as the “theory of neural counter currents” deduced from physiological statements which are inaccurate, and a theory of the origin of motor and sensory decussations which is difficult to harmonise with the appearance of such decussations very low in the animal scale, but also entirely disregards the nature of the sensory pathways except for the number of times they cross the central axis An admirable feature of the whole book, however, is the emphasis which it lays on the necessity for adequacy of stimulus in appraising reaction

Our Bookshelf

Bird Watching on Scolt Head By E L Turner Pp viii + 84 + 47 plates (London *Country Life*, Ltd, 1928) 10*s* 6*d* net

IN the present volume Miss Turner gives us the results of her two years' watching on Scolt Head, one of the sanctuaries run by the Norfolk and Norwich Naturalists' Society Miss Turner is one of those very few people who possess not only keen powers of observation, a wonderful knowledge of bird life, with an immense store of energy and perseverance in carrying out any work upon which she embarks, but, fortunately for us, also has the ability to set forth the results of her work in a most charming manner

Naturally, everyone will not agree with all the opinions which Miss Turner expresses, but, even where we disagree with them, we shall be none the less interested in what she tells us, or the less pleased with the manner in which she does it Scolt Head is now undoubtedly one of the most interesting sanctuaries in the whole of Great Britain, both on account of the many birds which breed there and because it forms a wonderful resting ground for migratory birds on both their spring and autumn travels Miss Turner's work lay principally with the breeding birds, but during her long months' vigils she lost no opportunities of dealing also with the visitors to her island, and the oldest observers may learn something from her work on Scolt Head Even the keenest of Nature lovers make slips sometimes, and we should like to have seen the dwarf fire crest which Miss Turner says measured only 2½ in *across* the wings, perhaps she meant 4½ in

The book is profusely illustrated with very beautiful photographs, both of the birds themselves and of the scenery in which they live, the paper on which the text is printed is good and light, and the book is a pleasure to read without being a labour to hold

(1) *Atomic Structure as modified by Oxidation and Reduction* By Dr W C Reynolds Pp viii + 128 (London Longmans, Green and Co, Ltd, 1928) 7*s* 6*d* net

(2) *La structure du noyau de l'atome, considérée dans la classification périodique des éléments chimiques* Par Charles Janet Pp 67 + 3 planches (Beauvais Imprimerie Departementale de l'Oise, 1927) n p

(1) THERE are no problems of greater interest at the present time than those of atomic structure as elucidated by the study of emission and absorption

spectra This study has the merit of providing a rigid experimental basis for chemical doctrines of valency and of molecular structure, but the author ignores all this valuable material and prefers to rely on imagination rather than on knowledge of the behaviour of electrons In these circumstances a responsible teacher might well be excused if he advised his students to seek wisdom elsewhere, and to spend their money in purchasing a real romance from the learned pen of Mr J J Connington (who, we believe, is in private life a professor of chemistry), rather than spend both time and money in an effort to distinguish between fact and fancy in Dr Reynolds's tables of atomic structure

(2) A similar criticism can be made of Janet's study of the structure of the nucleus At a time when the relevant energy levels are being deter mined experimentally from the properties of β rays, the value of a purely imaginative study of the distribution of electrons and protons in the nucleus is surely negative rather than positive, since it represents a dissipation of energy which might have been converted into useful work

Contributions to Analytical Psychology By C G Jung Translated by H G and Cary F Baynes (International Library of Psychology, Philosophy, and Scientific Method) Pp xi + 410 (London Kegan Paul and Co, Ltd, New York Harcourt, Brace and Co, Inc, 1928) 18s net

IT is several years since Jung's "Psychological Types" was published in this series, and the present volume is the first of the author's works to appear in English since then It is well known that there is, under the name psycho analysis, no common body of doctrine which is held by its most distinguished representatives Attempts have been made to show that the theories of Freud and Jung, for example, are not so antagonistic as they seem One such attempt constitutes a volume in this same series But Jung himself can scarcely keep within the bounds of polite language in denouncing the Freudian sex hypothesis as a fanatical creed The volume before us is full of interest from cover to cover, and it well exemplifies what the reviewer regards as Jung's reasonableness and sanity He applies his theories to problems of modern life, in cluding women in Europe, marriage as a psycho logical relationship, analytical psychology and the poetic art, and analytical psychology and education It is to be noted that, apparently on the principle that one cannot touch pitch without soiling one's fingers, Jung eschews the term 'psycho analysis' He prefers the term 'analytical psychology'

Der Bau der Erde eine Einführung in die Geotektonik Von L Kober Zweite neubearbeitete and vermehrte Auflage Pp iv + 499 + 2 Tafeln (Berlin Gebrüder Borntraeger, 1928) 27 60 gold marks

THE first edition of this work appeared in 1921, and was a series of discussions of tectonic problems rather than a text book This present edition practically amounts to a new work, for much of the arrangement, terminology, and substance is new The book now consists of five hundred pages compared with the three hundred of the first edition Prof Kober justly claims the present work as the first text book of geotectonics The book certainly stands alone, it is approached by some recent German publications, but there is nothing in English of the same calibre

The author, starting with the division of the earth's crust into kratogenetic (stable) and orogenetic (mobile) zones, proceeds to discuss these divisions with respect to facies, movements, and mountain building The results are applied to the continents and oceans in turn Finally, many theories, such as those concerning the origin of continents and oceans, are summarised The book is up to date, it includes, for example, an account of Stille's work in Saxony, of G M Lees' work in the Persian Gulf, and of the results obtained by the *Emden* during echo sounding cruises in 1927

The typography is good, illustrations adequate, and misprints few The bibliography is not up to the standard of the book, and an index would have been useful for a volume of this size

Recent Advances in Hæmatology By Dr A Piney (Recent Advances Series) Pp x + 318 + 4 plates (London J and A Churchill, 1928) 12s 6d net

THE demand for a second edition of this book within twelve months of the appearance of the first is an indication of its well deserved popularity Dr Piney has made additions to every chapter, in order to include the most recent views on all aspects of his subject, and a new chapter is given describing the spleen in various infections

The author considers hæmatology on an essenti ally morphological basis Modern views on blood chemistry are therefore not included, and, as is pointed out in the preface, the term hæmatology is not generally intended to cover the subject of serology Treatment is discussed in relation to each disease or group of diseases, little progress has been made recently in this direction, but the administration of liver in the treatment of pernicious anæmia is mentioned The glossary is very useful to those not familiar with pathological terms, and there are numerous references to original articles and text books

A Manual of Elementary Zoology By Dr L A Borradaile (Oxford Medical Publications) Sixth edition Pp xvi + 683 + 25 plates (London Oxford University Press, 1928) 16s net

THE principal alterations in the sixth edition of this excellent and well produced text-book are the revision and extension of the chapters on sex, embryology and evolution A "concise account"—about a page—of the snail (*Helix*) has been added, but this is too short to be really serviceable It contains no description either of the reproductive apparatus or the ganglia—the former is simply noted as "complicated, hermaphrodite" and the latter as "concentrated into a clump around the gullet" The figure of the senile form of *Entamœba* with buds might have been omitted

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications]*

The Mass-Spectrum of Lead from Bröggerite

IN the issue of NATURE for Mar 2, 1929, Dr Aston gives the results of his determination of the mass spectrum of a sample of lead in the form of its tetramethyl compound, of which the lead had been extracted by us from a sample of Norwegian broggerite We obtained the lead in the form of chloride, and took particular care to have it free from impurities The conversion of the chloride into tetramethyl was kindly carried out for us by Mr S C Witherspoon, and care was taken to test all chemicals and reagents used to see that they were free from lead

Dr Aston discusses his results and reaches interesting conclusions, and a further discussion is given by Sir Ernest Rutherford It may be of interest to consider the matter further, in the light of our analysis of the mineral

The specimen was obtained from a trustworthy dealer and bore the label "Uraninite var Broggerite, Karlshus, Raado, Smaalenene, east of Kristianiafiord, Norway" It appeared to be homogeneous except for a little pink feldspar, mica, and quartz, and was of an iron grey colour and of the general appearance of massive magnetite, but with some crystal faces Close examination showed no evidence of its having been acted upon by weathering processes Our analysis is as follows

U_3O_8 = 72 12 per cent	equi-		U = 61 158 per cent
ThO_2 = 4 98 ,, ,,	valent		Th = 4 377 ,, ,,
PbO = 8 64 ,, ,,	to		Pb = 8 018 ,, ,,

We have confidence in the essential accuracy of these figures

For calculating the age we used the formula given by the International Critical Tables of the National Research Council

$$\text{Age} = \frac{\log (U + 0\ 38\ Th + 1\ 156\ Pb) - \log (U + 0\ 38\ Th)}{6\ 5} \times 10^{11} \text{ years} \qquad (I)$$

This gives an age of $919\ 5 \times 10^6$ years for this mineral Changes which might be made because of some variation in the values of the disintegration constants involved in the factor 6 5 of the formula are not likely to be of large amount The calculated age is in good agreement with previous determinations by others on uranium minerals from the same general locality We may now compare this value with results obtained by making use of Dr Aston's figures in connexion with our analytical results

Dr Aston gives the figures 86 8, 9 3, and 3 9 as the percentage values obtained for Pb^{206}, Pb^{207}, and Pb^{208} present in the lead tetramethyl Of these isotopes of lead, the first and second have presumably been derived from uranium and its isotope actino uranium, and the third from thorium In analysis, uranium^{238} and actino uranium are necessarily determined together as 'uranium', and their disintegration has resulted in Pb^{206} and Pb^{207} respectively Calculations of age from these elements, disregarding thorium and Pb^{208}, should give practically the same result as the original calculation, and these results in turn should agree with the result that thorium and Pb^{208} give For uranium plus actino uranium we express the formula as

$$\text{Age} = \frac{\log (U + 1\ 156\ Pb^{206+207}) - \log U}{6\ 5} \times 10^{11} \text{ years} \qquad (II)$$

and get

$$\text{Age} = 908\ 4 \times 10^6 \text{ years}$$

This may be considered a satisfactory agreement with the $919\ 5 \times 10^6$ years previously obtained

For thorium and its lead we have

$$\text{Age} = \frac{\log (0\ 38\ Th + 1\ 156\ Pb^{208}) - \log (0\ 38\ Th)}{6\ 5} \times 10^{11} \text{ years} \qquad (III)$$

From this calculation, however, we get the result

$$\text{Age} = 1313 \times 10^6 \text{ years},$$

which is widely different from the previous figures

It is pertinent to inquire as to the probable cause of the discrepancy

In Dr Aston's account he expresses some uncertainty as to relative intensities of the lead lines, and gives a margin of possible error of ± 2 for Pb^{208} In view of the small total quantity of Pb^{208}, this means a large percentage error, the possible variation running from 5 9 to 1 9 per cent and corresponding ages (calculated by formula III) running from 1900×10^6 to 671×10^6 years The limits of error, therefore, include the value $919\ 5 \times 10^6$ deduced from the original calculations, but if this is accepted as correct, Dr Aston's figure for Pb^{208} apparently requires correction to bring it into harmony The limits of error he himself sets likewise point to the desirability of greater refinement of photometric measurement in order to make the results serve for age calculations Instead of 3 9 per cent of Pb^{208} given by him, our figures indicate 2 64 per cent, which is obtained by substituting in formula III the age $919\ 5 \times 10^6$ years and the analytical value of thorium, and solving for Pb^{208}

There is, however, another aspect of this matter which should be considered Formula III involves the factor 0 38, accepted as expressing the disintegration equivalence of thorium in terms of uranium It may be thought that it is this factor which should be revised, as there has been some variation in determinations of the value of this quantity among different experimenters As a basis for judgment in this matter we may make a new calculation of the conversion factor from the data supplied by Dr Aston For this purpose we combine formulæ II and III in the form

$$\frac{U + 1\ 156\ Pb^{206+207}}{U} = \frac{x Th + 1\ 156\ Pb^{208}}{x Th} \qquad (IV)$$

and solve for x

Such a calculation does not involve the correctness of the constants in the uranium series, but only the value of the conversion factor required to get identical results for the uranium series and the thorium series

Proceeding in this manner, we get the result 0·57 Possibly it may be regarded as an open question whether the accepted value 0 38 obtained by direct measurement by physicists does not require correction to bring it into closer accord with the figure 0·57 derived from Dr Aston's work, but in reading Dr Aston's letter we are left with the impression that Dr Aston himself does not wish to be held too strictly to the numerical values that he gives

Furthermore, previous work by one of us (*Amer Jour Sci*, November 1928) has given support to the substantial correctness of the figure 0·38 Two

minerals from a certain deposit in Brazil were analysed, after taking means to remove weathered products One was a uranium mineral carrying little thorium, and the other was a thorium mineral carrying almost no uranium From the results the ages were calculated using for thorium the equivalence ratio 0 38 The ages found for the two were in close agreement

The investigation of which the results have been reported by Dr Aston, was suggested (by C S P) in the hope of obtaining a direct determination of uranium lead (Pb^{206}) and thereby improving the accuracy of the existing formula for calculating ages It was also hoped that the uranium thorium equivalence factor (0 38) could be independently determined and perhaps improved, in order that the determination of geological ages might be rendered more certain From a consideration of the matter in the light of the analysis, it seems probable that a higher degree of precision in the measurement of the intensity of lead lines will be necessary in order to attain these ends We hope that future work by Dr Aston will bring this about In any event we are happy to know that our sample has been useful to Dr Aston in finding fairly conclusive evidence of the existence of actino uranium

C N FENNER
C S PIGGOT

Geophysical Laboratory
Washington, D C,
Mar 25

Estimates of the Ages of the Whin Sill and the Cleveland Dyke by the Helium Method

THE helium method of measuring geological time originally devised by Lord Rayleigh has hitherto been applied only to minerals or other materials that were found to be relatively rich in the radioactive elements, uranium and/or thorium It is already well known that the results obtained are to be regarded as minima on account of the special tendency of accumulated helium to escape from such specimens during their exposure to the atmosphere and during their preparation for analysis This tendency is necessarily most marked in old and richly radioactive minerals like uraninite and thorianite, in which large quantities of helium have been generated (for example, 10 c c per gm) In very feebly radioactive materials, like ordinary igneous rocks the amount of helium is correspondingly minute (for example, about 10^{-4} to 10^{-5} c c per gm), and its proportion to that of other gases (about 1 c c per gm) is very low The ordinary gases of an igneous rock are not appreciably extractable by a pump, even when specimens are ground *in vacuo*, nor, as a rule, do they begin to escape in appreciable quantity as a result of heating, until the temperature exceeds 300° C It is therefore to be anticipated that the loss of helium from specimens of close grained igneous rocks awaiting analysis will be much less serious than that from radioactive minerals

The technique introduced by the late Sir William Ramsay, and developed by Prof Collie and by Lord Rayleigh, for the determination of minute traces of helium has recently been still further improved by Prof F Paneth and, independently, by Dr R W Lawson It is now possible to measure with a reasonable degree of accuracy the helium accumulated in ordinary igneous rocks, even if their geological ages date from epochs no more remote than those of the Tertiary In the case of plateau basalts, possibly some 40 million years old, the average radium and thorium content is such that the accumulated helium should be of the order 10^{-5} c c per gm With modern methods amounts down to 10^{-8} c c can be estimated, and therefore quantities of the order found in rocks and ordinary rock forming minerals are readily determinable

With these considerations in mind the helium method has been successfully applied to two north of England rocks (the Whin Sill and the Cleveland Dyke) that have recently been under detailed petrological investigation (A Holmes and H F Harwood *Min Mag*, 21, pp 493 542, 1928, and 22, pp 1 52, 1929) The determinations of radium and thorium were carried out (by V S D) in the laboratories of Prof H Mache at the Radium Institute Vienna, while those of helium were done in Prof Paneth s laboratories in Berlin (also by V S D) The materials used for these determinations were in each case parts of the specimens already analysed chemically and mineralogically in the course of the investigation to which reference has been made The following are the results obtained

Rocks Investigated	$Ra \times 10^{12}$ gm /gm	$U \times 10^{6}$ gm /gm	$Th \times 10^{6}$ gm /gm	$He \times 10^{6}$ c c /gm
Whin Sill Scordale Beck, Westmorland (No 551)	0 27	0 81	3 0	36 0
Cleveland Dyke Bolam Co Durham (No 402)	0 61	1 83	6 1	11 0

The approximate age (omitting a negligible time correction for the wearing out of uranium and thorium during the life time of the rock) is given by the formula

$$\frac{He}{U + 0\ 29\ Th} \times 8\ 5 \text{ million years,}$$

where U and Th are the percentage contents of the rock in uranium and thorium, and He is the volume in c c of helium at N T P in 100 gm of the mineral (A Holmes and R W Lawson Factors involved in the Calculation of the Ages of Radioactive Minerals *Amer Jour Sci*, April 1927, pp 334 5)

From the data of the above table the ages are found to be

Whin Sill	182 million years
Cleveland Dyke	26 million years

The Whin Sill was injected into the Carboniferous rocks of the north of England in very late Carboniferous times The Cleveland Dyke was injected in post Liassic time, and the recognition of its definite status as an outlying member of the Mull dyke swarm points more closely to an early or middle Tertiary age The numerical ages are thus seen to be in excellent agreement with the geological evidence They also conform quite satisfactorily with the scanty results based on lead ratios The latter give 192 million years for the late Carboniferous (Joachimstal pitchblende provisionally corrected by atomic weight evidence for primary lead), 36 million years for the (?) late Miocene (brannerite from Idaho, uncorrected), and 66 and 52 million years for the late Cretaceous (pitchblendes from Colorado and Wyoming respectively, also uncorrected)

While it is probable that the helium results may be slightly low, it must be remembered that there is no real proof of this, for the lead ratios cited are themselves not yet so securely founded as one could wish There may be traces of primary lead in the Tertiary and late Cretaceous pitchblendes of North America, and, if so, the figures given would be too high The Joachimstal evidence, while generally consistent, suffers from the fact that the specimens analysed were

not the specimens from which lead was separated for atomic weight determination

Clearly there is a vast field of geological research now open to investigation by the long neglected helium method If our initial hopes are realised—and these preliminary results provide ample encouragement—a method is now available for dating all fresh igneous rocks which have not been heated up or metamorphosed since they came into place There should not be the slightest difficulty for example in distinguishing Carboniferous dykes and sills from those of Tertiary age It should be equally easy to settle with certainty the controversy as to whether the Carrock Fell complex belongs to the Ordovician or to some later epoch of igneous activity There are many such problems awaiting solution in every country where igneous rocks occur Moreover since igneous rocks suitable for the helium method are far more abundant and far better distributed in time than are radioactive minerals suitable for the lead method there is now available a practical means of effecting long distance correlations and of building up a geological time scale which checked by a few reliable lead ratios here and there should become far more detailed than could ever be realised by means of the lead method alone

Further work is in progress on the north of England rocks and it is our intention as soon as possible to begin the systematic prosecution of this extremely promising line of research Dr R W Lawson has consented to collaborate in the work by making the helium determinations and by carrying out a quantitative investigation on the possibilities of escape of helium in various circumstances

V S DUBEY
Department of Geology and Mining
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ARTHUR HOLMES
The University, Durham, May 6

A Case of Siamese Twins in the Spiny Dogfish (*Squalus fernandinus*)

THE occurrence of a case of Siamese twins in fishes has, so far as we are aware not previously been recorded The present example was recently discovered by one of us (J M) amongst the material collected during the survey of the Cape seas by the s s *Pieter Faura* about twenty five years ago Unfortunately, no records of the finding of this abnormality appear to have been kept and one can therefore only speculate as to how it was originally found

It is well known that this particular species of dog fish is viviparous, the female giving birth to as many as half a dozen young at a time In the dissection of the uterus of a gravid female, the young are found to be fully developed except for the possession of a yolk sac, which in these cases takes on the function of a yolk sac placenta, being in intimate contact with the wall of the uterus, which appears to be specially folded to receive the surface of the yolk sac At birth, the young is born fully developed, the yolk having been completely absorbed, the yolk sac having shrivelled up

In the Siamese twins', as is well shown in the accompanying photograph (Fig 1), the umbilical cords are still present, each embryo being provided with one One is struck by the position of these cords, which here have their exit in the neighbourhood of the pectoral girdle as opposed to the normal abdominal position The integument and the muscles surrounding the bases of these cords were incomplete, so that a large opening was left for the exit of the cords, the coelom thus being in direct communication with the exterior

The fact that the umbilical cords were still visible externally—the yolk sacs had apparently been broken off for they are entirely absent from the specimen—leads one to the conclusion based on the advanced state of development of the new born young that the twin was found during the dissection of the uterus of a gravid female

FIG 1 Siamese twins (spiny dogfish)

A brief description of the external appearance of the abnormality may prove of interest The anterior ends as far back as the pectoral fins are free being attached to a single trunk and tail Thus we find that there are a pair of pectoral fins to each free thoracic part while the first and second dorsal fins are symmetrically developed in their normal positions Spines are developed in front of each dorsal fin The tail presents a peculiar appearance The caudal fin is double symmetrically developed about the median horizontal axis The part corresponding to the ventral lobe of the caudal fin of a normal individual is twisted through a plane of 90° so as to lie in the horizontal instead of the vertical plane This lobe of the caudal fin is also shown in Fig 1 Along this side of the caudal region a deep groove is continuous from this fin up to a line through the posterior ends of the second dorsal The other caudal lobe is entirely absent The ventral fins are a single pair which has become displaced so as to lie laterally on one side of the trunk Each on its inner surface has a well developed clasper, while the single anus is also displaced and lies between the bases of the ventrals

The two heads are apposed by their ventral surfaces each being perfectly normal the mouths and nostrils facing each other The normal five pairs of gills are also present on each head

FIG 2 —Transverse section along line A B of Fig 1 to show duplication of the vertebral column etc *c* centrum *gr* groove *h.a.* hæmal arch *l a* lateral arch *m* myomeres *n a* neural arch *n sp* neural spine *sc* spinal cord

It has not yet been possible to make a detailed dissection of the specimen but a transverse section across the tail, just behind the second dorsal fin shows that the vertebral column is double each column appearing symmetrical about the median horizontal plane A vertebra of each column consists of a centrum, the neural arches forming the neural canal in which the nerve cord lies and ending in the neural spine On the side of the groove above referred to, there appears a single lateral arch with spine lying against the base of the groove enclosing a lateral blood vessel The two centra are separated by a space bounded above and below by the centra on one side by the laterally placed arch, and on the other by a sheet of cartilage This space is divided by a horizontal membrane to form two hæmal arches in which the caudal veins and arteries run

We hope to make a detailed dissection of the various

internal structures in the near future in order to examine the various parts and to ascertain which are duplicated and which single.

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The Past Cold Winter and the Possibility of Long-range Weather Forecasting.

MODERN meteorology has made notable advances in forecasting the weather of the next day; but when it attempts to predict the weather for more than a week ahead, the percentage of successes does not exceed fifty at the most. One reason for this failure is to be found in the refusal of the modern meteorologist adequately to take into account in the problem of weather prediction of direct terrestrial influences such as that of the physical state of the surface waters of the oceans, even though he may be ready enough to take such an influence into account when dealing with one of those aerodynamical problems—for example the life history of an Atlantic 'depression'—which he regards as lying within his particular province. Another reason is his neglect of the 'Polar Front' theory of Prof. Bjerknes, one of the greatest authorities on aerodynamics and hydrodynamics.

Prof. Bjerknes regards the polar regions as caps of cold air maintained largely in consequence of the local accumulations of ice and snow, offering a kind of cold circular wall facing the warmer winds of temperate latitudes. He considers that in conjunction with the strongly heated equatorial regions, they set up a circulation which brings warm air aloft from the equator to the pole, there to be cooled and to sink, weighed down by its increasing density, until it is absorbed into the polar cap; that these reservoirs of cold air at the poles are constantly discharging their accumulated air towards the equator along the earth, in accordance with 'impulses' supplied by the region of low barometer around the equator; that the trade winds represent successful attempts on the part of such accumulations of polar air to reach the region of equatorial calms. He supposes, further, that the cyclones of the North Atlantic arise through the mixing of the cold and warm air masses along the margin of the polar cap (the so-called 'polar front').

It is clear that a great simplifying theory such as this offers a basis for long-range forecasting of the weather in our latitudes. If we accept the theory, it is not difficult to see that the general character of the weather over long periods may follow changes in the extent and shape of the region of cold sea, for the polar caps must, in the long run, coincide with the regions of coldest water. For example, the presence of a tongue of warm water projecting into Arctic regions, such as the so-called Gulf Stream of the North Atlantic, will push this boundary back towards the pole, and cause contrasts such as are offered in winter by the cold climate of Labrador and the relatively mild climate of Iceland.

We may consider now whether the past severe winter cannot be connected with some modification of the normal temperature of the seas within the area of exceptional cold. The immediate cause of the severe weather has clearly been the persistence of northerly and easterly winds over Russia and Central Europe circulating round an 'anticyclone' or region of high barometer over Scandinavia and Finland, which anticyclone has generally been separated from the area of high pressure that normally covers Siberia in winter by a region of relatively low pressure over Russia. Now Prof. Witting found in the Baltic in the summer of 1927 a layer of cold water at a depth of about 10 fathoms, beneath the very warm surface water, heated by the sun, having altogether a volume much greater than that of a whole normal year's outflow from the Baltic into the North Sea, and having a temperature about 10° F. lower than the average. The surface waters of the Baltic are derived ultimately from the mixing of the river water with that finally ascending from such deeper layers, and this cold water might well chill their surface waters, and the air in contact with them, for two years or more, in accordance with the time that the water might be expected to take in passing away along the Norwegian coast.[1] Such chilling would cause the anticyclones which are so apt to form over Scandinavia to be more than usually persistent, as has been the case this winter. In this way the action of the cold water, which is far too small to produce directly a degree of cold such as has been observed, may do so indirectly through the agency of the wind, and the resulting accumulations of ice and snow will carry the process still further.

It seems clear that if the action of a single sea such as the Baltic can be so great, there is a great field open for international co-operation in the systematic study of the physical states not only of the Baltic but also of all the seas and oceans in and around Europe, including the Caspian and the Black Sea. This should be done once a year if not twice, and the results should be published quickly, so as to be available for long-period weather forecasting. This was in fact the policy of the International Council for the Exploration of the Sea before the War. It is hoped that the remarks that I have made will show that permanently to abandon such a scheme may be to throw away the opportunities of saving millions of pounds that would be afforded by the prediction, in good time, of winters such as that of 1928–29.

W. J. PETTERSSON.

Refraction of Light Waves by Electrons.

IT is an established fact that wireless signals transmitted from any place are readily received at the diametrically opposite place on the globe. The explanation usually given of the phenomenon is that the ions in the Heaviside layer make the speed of propagation of the waves greater in that layer than in the ordinary air below and thus bend the waves round the earth by a process of refraction. Larmor has developed the mathematical theory of the refraction (*Phil. Mag.*, December 1924), and has shown that if c is the velocity of light in vacuum and c' in the presence of electrons, then c and c' are related by the equation

$$c'^{-2} = c^{-2}\left(1 - N\frac{e^2\lambda^2}{\pi m}\right),$$

where N is the number of electrons per unit volume, e and m are the charge (in e.m.u.) and the mass of an electron, and λ the wave length. Assuming $\lambda = 10^5$ cm. for radio waves, calculations show that an electron density of 0.3 per c.c. is enough to produce the observed bending round the earth.

In the case of light waves, λ is of the order of 10^{-5} cm. This will lead to a large value of N in order that light waves may bend round the earth. If the refraction of light waves by electrons is to be observed in the laboratory, the curvature of the rays has to be much larger, and hence a still larger value of N will be required.

So far as we are aware, the bending of light waves by electrons has neither been attempted nor its possibility discussed. For some time past we have been

[1] The brackish water leaving the Baltic by the Oeresound and the Belts afterwards forms the 'Baltic current' along the west coast of Sweden and Norway.

experimenting to detect this effect, but before trying the actual experiment we thought it worth while to discuss if, under ordinary laboratory conditions, it is possible to obtain a sufficiently dense cloud of electrons to produce observable bending of a light beam. The results of our theoretical deductions are here set forth.

Langmuir has shown (*Phys. Rev.*, April 1923) that the density of space charge (ρ_0) at the surface of a plane hot surface is given by the equation

$$\rho_0 = 19260 \times i_0/\sqrt{T} \text{ e.s.u. per cm}^3$$

where i_0 is the saturation current expressed in amperes per sq. cm. of the hot surface at temperature T °K.

The density of space charge (ρ) at a distance y from the surface is also given by

$$\rho = \rho_0/(\sqrt{2}\,L_0\,y + 1)^2$$

where $I_0 = 4.59 \times 10^5 \times T^{-\frac{3}{4}}\sqrt{i_0}$ cm^{-1} expressed in amp. A thoriated tungsten filament of diameter 0.155 mm. and containing 1 per cent. ThO_2 gives an electronic current of about 20.5 amp./cm.^{2} at temperature 2300° K. (cf. Langmuir, *Phys. Rev.*, October 1923). If we take a strip of thoriated tungsten giving this current at this temperature, then ρ_0 will be equal to 8232 e.s.u./cm.^{3} and the density N of electrons at the surface of the hot strip is found to be 1.724×10^{12}. Also since $L_0 = 6258$ (approximately) the density (N) of electrons at a distance y is $1.724 \times 10^{12}/(8850y + 1)^2$. The expression shows that the electron density decreases rapidly with increase of distance from the strip. This variation of density will produce a curvature in a beam of light passing over the surface of such a strip. Since to a first order of approximation the refractive index $\mu = c/c = 1 - N e^2\lambda^2/2\pi m$, the curvature of the beam at a distance y from the strip will be

$$-\frac{d\mu}{dy} = \frac{e^2\lambda^2}{2\pi m}\,\frac{dN}{dy} = -\frac{4.6 \times 10^{-5}}{(8850y + 1)^3}$$

for sodium light $\lambda = 5.8 \times 10^{-5}$, the negative sign indicating that the beam will bend away from the strip.

At the surface of the strip ($y = 0$) the curvature of the beam will be numerically equal to 4.6×10^{-5}. If we assume that this curvature is maintained throughout the passage of the light over the whole length of the strip, say 10 cm., then the light beam which on entering the electron atmosphere just grazes the surface of the strip at one extremity will on emergence at the other extremity be shifted through a distance of 2.3×10^{-3} cm. from the surface. This shift will evidently be greater than the actual shift, since the expression for the curvature given above shows that it is not constant but that it diminishes rapidly with the increase of y—the distance from the strip. A more detailed calculation shows that the actual shift will be approximately equal to 7.8×10^{-4} cm. This shift, though small, should be detectable if suitable experiments can be arranged.

The smallness of the shift is due to the fact that the emitted electrons are mostly concentrated near the surface of the strip. At a distance of only 0.1 mm. the electron density falls to one ten-thousandth part of its value at the surface. A more favourable condition for bending the light beam will possibly be set up if the electron cloud is pulled upward by a positively charged plate held a few millimetres above the surface of the hot strip.

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April 11.

An Experimental Investigation of the Thermal Relations of Energy of Magnetisation.

THIS note is a first report of experiments undertaken for the purpose of determining the mechanism of the degradation of energy which accompanies magnetisation in ferromagnetic substances. The present experimental method consists in observing the change in temperature of a test specimen produced by a change in the magnetising force at consecutive intervals in a single cycle of magnetisation.

The test specimen is in the form of 106 bars of soft steel drill rod 1 mm. in diameter. The bars are so mounted as to form 8 coaxial concentric cylinders, and the lengths of the cylinders are so determined as

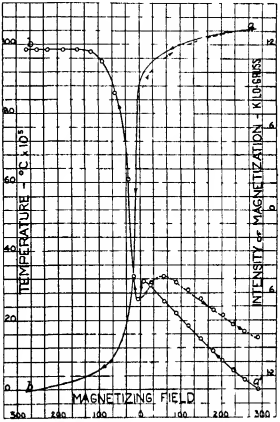

FIG. 1.

to give the aggregate the form of an ellipsoid of revolution the minor and major axes of which are 3.4 cm. and 60 cm. respectively. 106 copper bars of the same dimensions alternate with the steel bars in the structure. 106 thermocouples are constructed by connecting adjacent copper and steel bars alternately with 3 mm. lengths of No. 40 copper wire and No. 34 constantan wire. A coil around the centre of the ellipsoid permits the evaluation of the total magnetic flux in the specimen. The entire specimen is imbedded in rice powder and placed in an evacuated, silvered glass tube. Adequate thermal insulation isolates the latter from the magnetising solenoid in which it is placed.

The stability of the entire electrical and thermal system is indicated by a zero shift of 2 mm. per hour on a scale 6 metres from the thermocouple galvanometer. A measure of the uniformity of the magnetising field in the ellipsoid is obtained by connecting

half the thermocouples (associated with the inner bars) in opposition to the other half In these circumstances a reversal of the full magnetising field, which produces a rise in temperature of the steel corresponding to a galvanometer deflection of 220 mm, yields a deflection of only 4 mm

The results of the investigation are given by the accompanying curves (Fig 1) where intensity of magnetisation and temperature are plotted against true magnetising field Curve *ab* is the upper part of the usual 'hysteresis loop' for the steel The dotted portion indicates the loop obtained when the impressed field is reduced to zero and then restored to its former value The curve *a b* shows the total change in the temperature of the steel at every stage in the process of demagnetisation and reversal of magnetisation The dotted curve shows the total change in temperature corresponding to the process indicated by the dotted portion of the hysteresis curve

The not inconsiderable cooling of the steel in the neighbourhood of zero magnetising field, as well as the continued cooling accompanying remagnetisation on the upper part of the hysteresis loop are notable features of this record

Walter B Ellwood

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New York U S A, April 10

Mine Lighting and Retinal Sensitivity

In the review of Dr Whitaker's recent book on 'Mine Lighting' in Nature of Mar 2, p 310 reference was made by the reviewer to the causes of miner's nystagmus I have not had the opportunity of examining the book myself, and therefore do not know what factors are considered to be most significant in producing this troublesome ocular disease

In my own investigations, however I have discovered several actions of light upon the retina which are probably of fundamental importance in this connexion When the retina is stimulated by white or coloured light with an intensity below a certain critical value—*a* intensity—an inhibitory reaction is evoked which depresses the sensitivity of the visual receptors, whereas if the light is above that value their sensitivity becomes enhanced Thus a feeble light of *a* intensity is doubly harmful, first, because the intensity is too low for comfortable vision without eye strain, and, second because its reflex action is inhibitory in character

In coal mining the source of light is of low intensity and the reflecting power of the coal surface is also low It can scarcely be doubted, therefore, that the intensity of light reaching the retina is below the threshold enhancing value, and thus it maintains the receptors in a much depressed condition

The prevailing view of the visual functions of the spectrum has been to regard all colours or wave frequencies as factors contributing only to the formation of the white sensation Undoubtedly they have this effect, but it is far from being the whole truth, or perhaps even the most important part of the truth Each wave frequency is an energy stimulus of a distinctive physiological character the complete functions of which are yet unknown I have found, however, that the enhancing power of violet light above the *a* intensity is about seven hundred times as great as that of yellow Thus it follows that since violet contributes very little to the illuminating power of a light, its chief use when above *a* intensity is to act as a sensitiser of the retina for the reception of the illuminating colours, a function which it performs with extraordinary efficiency

I have seen it stated that during the War the Admiralty found the ability to distinguish objects on the sea at night or in feeble illumination was much increased by previously stimulating the observer's eyes with violet or blue light This is to be expected from the extraordinary enhancing power of violet light Probably the same procedure would be beneficial wherever observations are to be made with weak light, such as in the use of the microscope or in counting scintillations, etc

In mine lighting under present conditions the lamp seems to have too low an illuminating power and is probably greatly deficient in the sensitising violet rays On both accounts the retinal sensitivity is greatly depressed Under such conditions visual acuity and luminosity contrast on which it depends are both diminished in value

Possibly the miner's optical troubles could be diminished or even eliminated by obtaining an illuminant which will supply violet rays of the required intensity, and by raising the illuminating power of the light above the threshold enhancing value, which for white light appears to be about 0 25 metre candle

Possibly much improvement could be obtained even under present illuminating methods, if it is not impracticable, by preparing a quickly drying white material which the miner could smear over the coal face at which he is working, and so obtain the full benefit of such light as he possesses

Frank Allen

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Winnipeg April 16

Variations in Sex Expression in *Ranunculus*

We have now been working on problems connected with andrœcial and gynæceal variation in *Ranunculus* for several years and wish to supplement the remarks by Mr J Parkin in his letter published in Nature of April 13, p 568

Plants of *R acris* and *R bulbosus* with the stamens partially or entirely deficient in pollen production, and with correlated reduction in the size of the flowers, have long been known There are many scattered references in botanical literature to this condition Thus an interesting note on the subject was published in Nature so long ago as 1878 (vol 18, p 588), and other references are given in Knuth's "Handbook of Flower Pollination', ii 18, 24 (Engl transl 1908) and by Sorokin, *Genetics* (12, 59, 1927) Varying grades of 'femaleness' were noted by us at Kew in 1914 in three species of the genus, but the War and accumulation of work immediately after prevented experiments being carried out, though one of us mentioned their occurrence in a paper published in the *New Phytologist* (18, 254, 1919)

We have found all grades between plants with completely hermaphrodite flowers and those with no functional stamens The occurrence of every possible intermediate has made the work of scoring extremely difficult and, to a certain degree, arbitrary On the other hand, our method of scoring led to Whyte's interesting and important discovery of the time-factor as a cause of the appearance of hermaphrodite or unisexual flowers Little purpose can be fulfilled by giving a Latin name to the composite group of sex variations

Mr Parkin, rather surprisingly, does not refer to the living plant he kindly sent us This was a male plant, in that all its flowers were, and have each season remained, functionless on the female side It is the most interesting buttercup we have yet seen and it has been used in genetical experiments to

produce generations not yet scored beyond the F_1. The flowers have an increased number of narrow petals and, in general appearance, recall those of *R. ficaria*, yet it is certainly *R. acris*. The plant has been multiplied vegetatively, and good specimens are preserved in the Genetical Herbarium at Kew. So far as we know it is the only 'male' *R. acris* plant ever recorded.

We are inclined to think that Mr. Parkin's suggestion that *R. acris* is in the incipient stage from hermaphroditism to gynædiœcism (or even to complete diœcism) is not improbable. We made a similar suggestion in a paper on the genetics of *R. acris* and *R. bulbosus* recently sent to press. Our field observations have proved that in some populations—widely scattered in England and Scotland—the percentage of female or intermediate forms is very much higher than one per cent, and in some counts it even approximated to fifty per cent.

Lastly, we wish to ask any reader observing sex forms or any abnormalities in any British species of *Ranunculus* to send us living specimens for genetical and cytological analysis.

E. M. MARSDEN JONES.
W. B. TURRILL.

The Herbarium,
Royal Botanic Gardens, Kew, Surrey,
April 27.

The Arc Spectrum of Phosphorus.

THE arc spectrum of phosphorus has been investigated by Saltmarsh and by McLennan in the Schumann region, and the lines belonging to the fundamental transition $2M_2(M_2 \leftarrow\!- N_1)$ have been arranged according to Hund's theory by McLennan (*Trans. Roy. Soc. of Canada*, vol. 21, sec. 3, 1927).

The lines belonging to the second group of transition $2M_2(N_1 \leftarrow\!- N_2)$ lie, according to the horizontal comparison method of Saha and Majumdar, in the region ν 9400–10300–10800 (*Indian Journal of Physics*, September 1928, p. 72). Similarly, the lines due to the transition $2M_2(N_1 \leftarrow\!- O_2)$ have been located at 18000–20518.

The spectrum of phosphorus in the infra-red region has not yet been investigated, but as both silicon and sulphur are present in the sun, it was assumed that phosphorus should also be found. Taking the infra-red solar lines as given in the "Revision of Rowland's Preliminary Table of Solar Spectrum Wave-lengths," I located these lines with the aid of known differences $\Delta P_{1,2} = 151$, $\Delta P_{2,3} = 249$, in the regions predicted. The $4P - 4S_2$ lines and $4P - 4\bar{P}$ lines due to the transition $2M_2(N_1 \leftarrow\!- N_2)$ have been found at $\nu = 10555$ to 11095. Attempts are being made to verify the identification by taking a spectrum of phosphorus in this region.

The second group of lines, $2M_2(N_1 \leftarrow\!- O_2)$, were identified in a group of lines obtained by Geuter in the region λ4600–6000, and have been identified with a number of faint solar lines. The identification seems to be unmistakable.

I have thus obtained two successive members of a Rydberg sequence, and calculated the ionising frequency to be $\nu = 86521$, corresponding to a voltage of 10·68 volts. The ionisation potential of phosphorus is thus found to be slightly higher than that of sulphur, the element succeeding it in the periodic table. We have a similar case in nitrogen and oxygen.

The investigation thus establishes the presence of phosphorus in the sun.

D. G. DHAVALE.

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Mar. 18.

An Optical Method for Analysing Photographs of α-Ray Tracks.

MR. L. F. CURTISS, writing in NATURE of April 6, describes a method for examining stereoscopic photographs of α-ray tracks taken by two cameras at right angles. The method which we have been using for some years for the measurement of the lengths and initial directions of emission of β-ray tracks (originally suggested to us by Prof. C. T. R. Wilson) depends on the same essential principle as that described by Mr. Curtiss, and our experience confirms his observation of its accuracy and convenience. We described the method in a paper on "The Ranges of Secondary β-rays" (*Phil. Mag.*, 2, p. 1110, 1926) as follows: "The lengths of the tracks were obtained from the stereoscopic photographs by replacing the photographic plates in the cameras, illuminating them and tracing out the common image which coincides in space with the original track." We have also used the same method in an examination of the initial directions of emission of photoelectron tracks (*Proc. Roy. Soc.*, A, 121, p. 612, 1928). In the case of observations with β-rays, since the track is not in one plane, the use of the translucent screen (as described by Mr. Curtiss for α-rays) is not applicable.

In our experiments the axes of the two cameras were not at right angles, but were inclined at a small angle of about 20°. With this arrangement it is possible to *see* the track in stereoscopic relief, if, instead of holding a screen in front of the camera, we look through one lens with the right eye and through the other lens with the left eye. In actual practice this greatly facilitates the measurement of the tracks. A fuller account of the method will shortly be published elsewhere.

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E. J. WILLIAMS.

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The University,
Manchester.

Geotropism and Antennæ.

I HAVE just been listening to a discussion, at the Zoological Laboratory, arising from some interesting observations by Mr. G. L. Clarke on the tropisms of *Daphnia*. A question was asked as to the conceivable mechanism of geotropism in an animal very little heavier than water and with no air bladder, and an expert in crustacean appendages suggested that, as the animal slowly sinks, fine sensory hairs on the appendages are bent upwards.

It has since occurred to me that, when passively extended, *Daphnia's* two swimming antennæ, branched and set with long fern-like bristles, will offer relatively great resistance to movement downwards through the water, a resistance on a long lever which must be met on the short internal arm of the lever by at least ten times the force in the muscle or ligament involved.

The actual stimulus for geotropy (positive or negative) might therefore be either an increase in tone of the lower muscles of the antennæ, or a decrease in tone of the upper muscles. If this hypothesis be considered plausible, we have an explanation why nauplii and copepods have evolved these two disproportionately long swimming arms, in place of being content with the series of short equal paddles or cilia which suffice for so many other organisms. It is no longer remarkable that the most prominent swimming organ of the larva should be an important sense organ in the adult decapod—for it has always been a sense organ.

GEO. P. BIDDER.

Cambridge, May 1.

Science and the Classics[1]

By Prof D'ARCY WENTWORTH THOMPSON, C B , F R S

IT has been the rule from time immemorial, not the exception, for science and the humanities to go hand in hand Aristotle the naturalist wrote of poetry , Plato was a lover of astronomy , Theophrastus the botanist was a master of rhetoric, whom even Cicero admired , Celsus the physician was an encyclopædic scholar after the taste and fashion of his age When the humanistic tradition was at its height in the ' revival of learning,' Galen and Hippocrates were read by all Linacre the physician helped to bring Greek into England, and was one of the great scholars of his time Moreover our physicians have never lost but have richly inherited and enjoyed the classical tradition , Payne and Greenhill, Osler and Clifford Allbutt in our own time, were scholars after the manner of Haller and Boerhaave and Richard Mead and Sir Thomas Browne Cuvier, busiest of men, wrote a commentary on the natural history books of Pliny Linnaeus himself could write of Nature with a scholar's pen and look upon her with a poet's eyes the severe " Systema Naturae " was the work of one who fell on his knees when he beheld the sunlit gorse at Hampstead, and apostrophised mother Nature in words which sound like the echo of an Orphic hymn " Natura, Filia Dei, rerum omnium Magistra, autodidactos, indesinenter laborans, nunquam festinans," etc

If a man's mind be open to the influences of culture at all, he finds not a little of it within the range of his own profession, even though it be a technical one My own science of zoology looks a very different thing at my age from what it did forty or fifty years ago Around its bare facts have grown the stories and associations which travel, friendship, reading have supplied Loose threads have woven themselves into a web A fact discovered yesterday is balanced by the history of two thousand years Knowledge is no longer something learned in the study, but that is imbibed during one's wanderings through the world , not something which is contained in a book or books, but which in all lands and languages is part of the living speech and daily business of men, part of the common birthright of mankind

The faculty of weaving wider and wider associations around our work and thoughts, and of thus enlarging the horizon of our minds, is helped by that sympathetic attitude and spirit of which a broad education has laid the first foundations But again, the Muses are often kindest to those who have worshipped little at their shrine It is common nowadays for clever schoolboys to spend many hours of every day in a chemical laboratory, from the age (say) of fourteen an age at which we were learning Greek, and Plato's young Athenians were playing on the lute It might be supposed that our young chemists were laying up for themselves what Talleyrand called " une triste vieillesse " By no means So wonderful a thing is a schoolboy, such a piece of work is a man, that our schoolboy-chemists are little the worse of their narrow and eccentric education The learned chemist is still a learned man , in love and knowledge of the arts the chemists are scarcely beaten by the scholars Not a few are steeped in the romantic history of their science, know what is to be known of ancient Greek and Egyptian chemistry, search out the medieval secrets of the poisoner, the alchemist, and the magician, and are versed in the Arabic and other recondite languages in which so many secrets are hid

If it be an attribute or an end of culture to find something which shall take us out of our narrow lives, help us to forget the routine of our employments, and bring us in touch with the wide world, old and new, near and far away, to read history and poetry is a simple and time honoured way , nor is there better history or poetry than that which the dead languages enshrine Men who love these find them very helpful , they enable young men to see visions, they help old men to dream dreams

A few months ago a scholar died, full of years and of honour, in whom science and the classics were very perfectly combined Sir William Thiselton Dyer was the acknowledged head of English botany , as botanist and gardener his influence went out into all lands, to the benefit of mankind, from the garden where he had the happiness to dwell , and all the while he was a true scholar, a Hellenist, acute, fastidious, and profound

Thiselton Dyer learned his Greek and Latin in a London day school , so did I mine in Edinburgh —in that *Schola Nova* of Dunedin where my father had taught R L Stevenson and Andrew Lang and many another , had read the whole Aeneid through with them as beginners, and told them they were the first child mariners who ever circumnavigated that noble poem In seven years at school I never had a lesson in science, nor yet, I believe, had Dyer , but he and his companions, and I and mine, were botanists and naturalists in our teens It was a Golden Age, when there were no scholarships to win, no examiners to satisfy We had freedom to follow our bent, and leisure in which to teach ourselves

If there was one school-book which Thiselton-Dyer loved more than another it was Virgil's " Georgics " Virgil never fails us, nor wearies us, nor does custom stale his infinite variety The schoolboy thinks the " Georgics " an easy book , the old scholar knows it to be hard, finds in it *semper aliquid novi*, and is tantalised and fascinated by its difficulty There is a line near the beginning about the " slow months " of the year, wherein Augustus found his heavenly habitation " Anne novum tardis sidus te mensibus addas ? " Halley the astronomer, coming to Martyn's help, explained the line by the brief statement that " Leo, Virgo, Libra, and Scorpio are really of slower ascension than the other eight signs of the Zodiack , to which Virgil no doubt alluded " But scholars

[1] From the presidential address delivered to the Classical Association, Cardiff, on April 9

have been slow to accept an interpretation which seemed, as it seemed to Heyne, more subtle than poetic, and Conington declares that *tardus* "need be no more than a disparaging epithet, intended to exalt the power of Cæsar, who is to speed the year"! Dr Fotheringham has given me a full explanation, on Halley's lines The 'months' are signs of the zodiac, or the corresponding spaces which the sun travels over in a month Owing to the obliquity of the ecliptic the signs, or the corresponding spaces of 30°, do not rise above the horizon in equal times The calculation is somewhat technical, but the result is, briefly, that in the year 35 B C and the latitude of Naples, the four signs above mentioned took each about 2½ hours to rise, while Aries and Pisces, at the other end of the scale, rose in about an hour and ten minutes In other words, the signs round about the autumnal equinox took more than twice as long to rise as those about the vernal equinox, and the middle of the four 'slow months' lay precisely between Virgo and Libra or 'the Claws',—"Qua locus Erigonen inter, Chelasque sequentes, Panditur"

Dr Fotheringham tells me another fact, which was quite new to me namely, that what looks like, and is generally taken to be, a parallel passage in Manilius has an entirely different meaning "Ne mirere moras, cum Sol adversa per astra Aestivum tardis attollit mensibus annum" This refers to the sun's anomalistic' motion, which is fastest at perihelion and slowest at aphelion, that is to say, in classical times it moved fastest in Capricorn and slowest in Cancer, and 'mensis' here means the monthly course of the sun Now it so happened that the three signs in which the sun moved slowest, Gemini, Cancer and Leo, were precisely those in which (and in which alone) the zodiacal figures were depicted with the head or front towards the east So Manilius frames the conceit that the sun moves slowly because these *astra* are adverse

The naturalist, the botanist, and the astronomer, when they betake themselves to the classics, strive continually to interpret them as generations of their kindred have been doing for five hundred years Now and then a nail is set in a sure place, and the task continually advances, without ever coming to an end Some day, but not yet, Greece herself will help us Only of late has the botanist had a flora of Greece which he can depend upon, we are sadly ignorant of its fauna We long especially for better knowledge of its vernacular names of beast and bird and plant and creeping thing, such as are proving of deep interest to the naturalist and the scholar in the multitudinous dialects of Italy

The humblest task of the naturalist is the identification of species, but, both in biology and the classics, it lies at the root of the whole matter If we do not know the flower of which a poet sings, we blur the outline of his picture and miss his most delicate allusions You remember, in the "Oedipus Coloneus", how the clustering flowers of the narcissus, *ὁ καλλιβότρυς νάρκισσος*, spring up under the dew of heaven, and make the *μεγαλαῖν θεαῖν ἀρχαῖον στεφάνωμα*—the time honoured garland of the Magnae Deae My brother of our Greek chair brought me the passage only the other day, to ask me what flower *νάρκισσος* was, I told him (to begin with) that it was a *narcissus*, which is to say, a daffodil But we may read, in the "Hymn to Demeter", how Proserpine was gathering narcissuses, when she, poor maid, "by gloomy Dis was gathered" I thought she had her little foot on the unbending corn, and poppies in her hair! How came she to be picking daffodils, when the autumn was come, and she must be stolen away and leave her earth mother desolate and forlorn? The simple, pretty explanation is that we may find a tiny, late flowering daffodil, Virgil's "sera comantem narcissum", growing in Greece and Italy, on the dry hills where there is no moisture but the dew, it flowers with the autumn crocus, Sophocles' *χρυσαυγὴς κρόκος*, and lasts until winter comes Proserpine picked it with the last rose of summer and the crocuses, for her farewell nosegay, she took it down with her to Pluto's realm, and men call it her *ἀρχαῖον στεφάνωμα*

Our daffodils have little or no perfume But the old fifteenth century traveller Busbequius, the same who brought the Constantinople Dioscorides to Vienna (which Sibthorpe went to Vienna to see), found our little autumn daffodil 'miro odore fragrantem" When Proserpine picked her daffodil nosegay, such a fragrant incense smell went up that Heaven and earth and sea all laughed for joy

> *κηώδει δ' ὀδμῇ πᾶς τ' οὐρανὸς εὐρὺς ὕπερθε*
> *γαῖά τε πᾶσ' ἐγέλασσε, καὶ ἁλμυρὸν οἶδμα θαλάσσης*

We miss something, if we say that narcissus means a daffodil—and pass on!

One of my father's colleagues in Ireland was J F Davis, who edited the "Eumenides", he was a very learned but eccentric man Going home on one of my undergraduate vacations from Cambridge, I met Davis in a Galway street, who cried out from afar off—it was his only greeting "*Can* you tell me what plant Pliny's *Cassia* really was?" It happened that a German scholar had lately declared "Quid Cassiae nomine veteres appellarint, nunquam divinabimur" Now when Virgil and Ovid speak of cassia, along with thyme and rosemary, they mean marjoram, and it is so depicted in the Vienna Dioscorides Martial's *Cassia*, which was burnt for incense on a funeral pyre, was the Semitic name of a sort of cinnamon, brought home from India by the spice merchants Early commentators mix up the poisonous Italian spurge-laurel (a sort of *Daphne*) with both of these, and Pliny mentions them, all three If I had known as much as this fifty years ago, I might have given Davis a partial answer to his question But Pliny also mentions a kindred spice or drug, an evil-smelling spikenard from the Ganges, which he calls *Ozaenitis* a word which one would never doubt came from *ὄζειν*, 'to smell', if one did not know that so obvious a *Volksetymologie* was almost certain to be untrue This strange name and substance Thiselton-Dyer has ingeniously explained

If we enlarge our knowledge of ancient geography by the help of Greek and Arab geographers, we may

follow, with delight and wonderment, the old trade routes known to Sindbad the Sailor, and to Solomon the King The Periplus of the Red Sea leads us by one of these straight to the ancient city of Ozene, an entrepôt of the spice merchants It has changed neither its name nor its commerce, it is the rich city of Ujjain, in Gwalior, the busy centre of the Indian opium trade Dyer had the acumen to detect that *Ozaenitis* was spikenard from Ozene just as in Dioscorides, *Mossulitis* was *Cassia* from Mossylon, the ancient haven hard by Cape Guardafui where the spice merchants landed their costly bales —the 'aromaticae species quas mittit Eous"

When Carlyle was old he wished they had taught him the constellations when he was young, and "made him at home in the starry heavens" and I too wish I had learned as a child to read the picture book of the sky It is an infinitely noble and exalted theme It was the first art which grew into a science in the hands and minds of men Some say it gave mankind a first glimpse of the divine, by man's soul and by the stars of heaven Sextus the Mathematician declares that Aristotle found his way to God and it is written that the firmament showeth his handiwork The Greeks covered the sky with fairy tales—'fabulis Graii complevere caelum,' said Martianus Capella and Quintilian declares that no man can understand the poets if he be ignorant of astronomy— nec si rationem siderum ignoret, poetas intelliget"

On the threshold of this delightful study we are met by the cardinal fact that the panorama of the heavens is continually but very slowly changing so that the heavens of which Aratus tells are not our heavens, and Homer's pictures of the sky, though they are exquisitely true, are no longer to be seen by mortal men For the heavens have their Great Year, in which each month of the twelve is 2000 years long, and a single day is threescore years and ten Some hold this to be the true theme of the Fourth Eclogue The Great Year, the Old Year, is drawing to its close when 'Ultima Cumaei venit iam carminis aetas", and anon, when 'incipient magni procedere menses", the Great Year begins anew The Great Year and the precession of the equinoxes by which it is explained are doubly and trebly interesting to the classical scholar Its discovery is commonly attributed to Hipparchus, and constitutes his title to immortality, this is a crucial argument of those who hold that the Greek genius was alone capable of transmuting crude barbarian knowledge into true science and wisdom But the Assyriologists have lately found that this palmary discovery was made, at least essentially, two hundred years before Hipparchus, by Kidinnu, Pliny's Kidenas, of Sippur in Chaldea, and the Babylonian astronomer has his place henceforth among the greatest of men

Ulysses leaned on his long oar and watched the Pleiad and Bootes and the Bear—Boötes who sets so tardily, and the Bear who turns and turns about, and glares upon Orion, and never dips his feet in Ocean's stream But we who know that the Bear never sets in our northern sky, are surprised to find him setting like other stars, and by no means ἄμμορος ὠκεανοῖο λοετρῶν, when we go to the Mediterranean or the Aegean It is many a day of the Great Year since the Bears went dry shod over the Aegean, but to tell just when they last did so is a simple matter, in the art or science of astronomical chronology The Bear was ἄμμορος λοετρῶν ὠκεανοιο in the Mediterranean about 800 or 900 B C, and for some centuries before Homer tells us that on the night in question Boötes, Orion, and the Pleiad were all visible together and we may take it for granted that they formed a notable configuration the place and season of which men were accustomed to observe Ulysses was *navigating* by the stars but why mention so many stars for such a simple thing? We glance nowadays up at the sky find the Pointers and follow them to the Pole star in a moment But in Ulysses time there was no pole star nor had there been one for hundreds of years!

Greek mariners steered by the Great Bear, and Tyrians by the Little Bear, but both alike were makeshifts for neither Bear stood at the pole and neither could stand still Only in some particular position would either of them give the true north, and that position must be defined by other stars Suppose Ulysses out a sailing one October night, about a thousand years before the coming of our Lord a little before the dawn he saw Arcturus and the Pleiad, balancing one another as it were, one hanging above the eastern horizon the other over the west Down in the south west Orion was shining, the Bear was watching him with his two bright eyes just then these two eyes (which we call the Pointers) lay one to one side and one to the other of the meridian and the Bear himself, body and tail, stretched away into the north east from this meridian line Ulysses looked at the Pointers and knew he was facing to the north, he then kept the Bear on his left hand, in the position in which *it then was*, and so steered to the south west He was on his course to Scheria

The distinction between science and the classics vanishes away when we come to history archaeology, or folklore, wherein the object of our study is mankind Andrew Lang and a few others began to show us a generation ago, how there was a science in the homeliest words and things and the spirit of history in a game, an incantation, or a toy In the 'Pharmaceutria" of Theocritus we used to think the magic bird and magic wheel mere witchcraft, superstition, moonstruck madness—nothing more Then came Andrew Lang and the others, to show the wealth of meaning in these unconsidered things We have learned that the wheel still hums in the little hands of a Sicilian child, and that a kindred wheel roars its dull note in the hidden rites of the Australian bush It thundered in the horrid feasts of Cretan Zagreus, it sounded amidst the roll of drums, as in darkest Africa, for Rhea and Bendys and Cotytto Jason had it of Aphrodite, to bewitch Medea The Sicilian calls it a cicada, the Greeks knew it by a bird's name All the Orphic mysteries, and who knows what more out of the dark religions of the

East lie behind the story of the girl who sat under the Lady Moon a singing Turn wheel turn and fetch my own lad home to me

When my father was writing of the dead languages a dead civilisation had been but recently revealed the chance directed efforts of a traveller had shown the world that Nineveh and Babylon were seats of tranquil learning and treasured science before ever a fleet had sailed from Aulis or the eagles had promised empire to the watcher on the green Palatine More than once since then has discovery repeated herself raised up the ghost of empires which had gone down into the pit and called from sepulchral palaces the long procession of the dead To learn what Greece had of her science her religion her mysticism her genius her language and her blood from the civilisations by which her own was encompassed and preceded is to my mind the greatest puzzle of history the noblest problem for the scholar Were I a younger man I should want above all things to know Egyptian Assyrian and Hittite and all the rest of that pre Hellenic apparatus of the scholar which the last century has half revealed I have been dreaming all my life of the riches of this Promised Land a few grapes have been brought me from Eshcol—but I am come no farther than Mount Abarim

When the wind blows from Assyria it brings not only odours but also stray whispers to our ears We remember how in the comedy of the Birds the two Athenians who pass by the hoopoe s dwelling on their way to the building of Cloud Cuckoo Town come laden with basket earthen pot and myrtle twigs

> Trudging along with basket pot and myrtle
> To find some quiet easy going spot
> Where we may settle down and dwell in peace

The scholiast with the ignorance of his kind explains this paraphernalia as so many useful implements for scaring away the birds But now we learn that in an Assyrian text from the library of King Assurbanipal precisely these three things a box (or basket) an earthen pot and a myrtle spray are named in the self same order as sacred utensils to be used in connexion with *the founding of a city* Such is the ray of light thrown by modern archæology on a single and apparently insignificant line

Caput inter nubila condit — her head is muffled from our sight —was said of antiquity as also of fame and scholarship like science has her secrets to discover and her mysteries to explore

Whether we be taught science or the classics in our boyhood is not the last word of all B it which ever of the twain it be let us so learn it as to love it and so love it that we may love it to the end

α δ ἂν μαθῃ τις τα τα σ ζεσθα φ λε πρ ς γ ρ ς

Science and the classics The one says (in Wisdom s words) They that eat of me shall yet be hungry And the other says They that drink of me shall yet be thirsty And both alike continually enlarge our curiosity and multiply our inlets to happiness

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The South Africa Meeting of the International Geological Congress

THE High Court of geological opinion met for the first time in 1878 at Paris with a membership of 310 Since that year there have been thirteen meetings held at intervals of three years or so at various capitals or other centres in Europe as well as in North and Central America the long interval of nine years which separated the twelfth meeting in Canada during 1913 from the thirteenth session at Brussels in 1922 was due to the War and its aftermath

The present century is witnessing a remarkable extension—in theory and practice—of the principle of internationalism in many branches of human endeavour of this the pages of NATURE afford ample evidence For the geologist extensive travelling is indispensable and this is reflected in the steady growth in the number of those attending the sessions of the Congress the record gathering of 742 geologists representing some forty different nationalities is a striking testimony of the extent to which world co operation has grown in this science

For its fifteenth session the Congress meets during the last week of July and during August of this year in South Africa at the invitation of the Government of the Union with its headquarters at Pretoria The practical support from the Government as well as from the mining industry at Johannesburg and Kimberley from municipalities and other public bodies and from various generous friends has made it possible to arrange an attractive programme This is the first occasion on which the Geological Congress has met in the southern hemisphere and the exceptional opportunities which South Africa offers for the study of many fundamental problems of geology will make a strong appeal throughout the geological world Though the Union of South Africa is not yet known with a degree of detail comparable with that reached in some older countries where geological investigation—both official and private—has been carried on for much longer periods enough has been accomplished to allow one important function of the Congress—the examination of the outstanding geological features of South Africa—to be carried out with profit and interest to the visiting members Unfortunately the great distances involved make heavy demands on the geologist s time and purse but the efforts of the organising committee have met with a considerable measure of success so that substantial concessions have been granted by the steamship lines and the South African railway administration

The first main object of the Congress—to take stock of recent advances in geology—has in accordance with the excellent practice established at previous meetings enabled certain subjects to be placed in the foreground of the discussions The

important results that this excellent policy promises may be illustrated in the classic symposium on the origin of crystalline schists which makes the *Comptes rendus* of the London Congress in 1888 such a valuable record to the student of rock genesis Almost all the special topics set down for the meeting in South Africa clearly reflect several of the particular features in which the geology of that country deserves the special attention of the Congress Magmatic differentiation pre Pleistocene glacial periods the Karroo System its stratigraphy palæontology and world distribution to these rift valleys the genesis of petroleum and the geological work of micro organisms have been added by special request

Probably nowhere in the world are the phenomena of magmatic differentiation more superbly displayed in extensive outcrops than in the unique igneous complex of the Bushveld a petrographical province covering more than 16 000 square miles of country and including rocks that range from granite through norite and various ultrabasic types to massive segregations of almost pure magnetite and chromite frequently alternating with bands of that remarkable group—the anorthosite Needless to say this almost inexhaustible field of study long ago attracted the attention of the South African geologists—of whom Molengraaff State geologist of the former South African Republic was the first to recognise the genetic connexion between various members of the Complex By 1922 the more systematic survey of the Bushveld had advanced sufficiently to induce Prof R A Daly to organise a Shaler Memorial Expedition to South Africa with the special object (amongst others) of examining what Daly and Molengraaff describe as the largest and most remarkable igneous complex yet mapped

South African geological literature has been enriched by two most valuable contributions from the members of this expedition in the first Prof Daly and Prof Molengraaff discuss the structural features of the Bushveld Complex (*Journal of Geology* 1924) while in the second (*Bull Geol Soc of America* 1928) Daly gives a brilliant analysis of the petrographical and chemical aspects revealed by the major phases of the Complex The long excursion after this summer s session of the Congress specially devoted to the Bushveld follows closely the route traversed by Daly and his friends and the membership already secured promises not only valuable and profitable results but certainly also a stimulating experience for the South African geologists concerned It need scarcely be said that the curious occurrences of primary deposits of platinum for which the Complex is gradually assuming great economic importance including those strange and unique vertical tubes of dunite are not to be overlooked on this excursion

Since the days when Sutherland in 1868 first recognised the glacial origin of what is now firmly established as the Dwyka conglomerate the study of pre Pleistocene glacial periods has made great strides both in South Africa and in the other continents where Permo Carboniferous glaciation is in evidence and a special excursion will give a glimpse of the stupendous glacial activity which has left us with the remains of ground moraine spread over more than 17 000 square miles and demonstrate the superb striated floor etc of this Dwyka conglomerate for which the Kimberley neighbourhood has become so justly famous that one might call that region the glacial geologists National Park

Apart from the Permo Carboniferous South African geologists have recognised four other pre Pleistocene glacial periods all of which are older than the Dwyka In this recognition the late Geological Commission of the Cape of Good Hope has taken the principal part One of these can be traced in the glacial conglomerate of the Table Mountain sandstone of the Cape System in the Cape Peninsula etc Another is found in the Lower Witwatersrand System in the Heidelberg area while a third is reflected by the tillite in the Griquatown Series of the Transvaal System (N W Cape and Central Transvaal) The fourth period is that of the Numees Series in Namaqualand An examination of the majority of these glacial deposits is included in the programme of excursions and no doubt will furnish much material for interesting and helpful discussion

No apology is needed for selecting for discussion at a meeting in South Africa the stratigraphy palæontology and world distribution of the Karroo System which is *par excellence* in that sub continent covering approximately one half of the Union of South Africa with its rich reptilian fauna and instructive fossil flora with which geologists have become familiar through the researches of Broom Haughton Du Toit and others It is to be hoped that the palæontologists will not miss examining the exceptionally fine type collections of Karroo fossils which form a recognised feature of importance in the South African Museum at Cape Town The Karroo stratigraphy etc (including the profuse sills of dolerite) with some of its organic remains will receive special attention on the Cape Kimberley Port Elizabeth and Durban Zululand excursions the first named also covering good fossil localities of the (Devonian) Bokkeveld Series of the Cape System

A discussion on rift valleys is most appropriate to the venue of this Congress it is obviously a branch of tectonic geology of far more than local interest and its inclusion by special request on the part of those closely identified with this line of research is to be welcomed—no less than the offer by one of the latter to invite a symposium on this subject by means of an illustrated lecture

For the second main object of the Congress—a study of the geology of the country visited—the organising committee has evidently felt—and we cordially endorse its view—that in a country relatively so little known to geologists outside South Africa a large and varied series of excursions would make a special appeal and a study of the programme shows that in this respect the fifteenth Congress should certainly constitute a record since the twenty two excursions extend from Cape Town in the south northwards to Elizabethville in the

Congo, and from Lüderitzbucht on the Atlantic to Durban on the Indian Ocean, forming a network of journeys that cover an area one third the size of Europe! Yet this comprehensive programme is so skilfully worked out that every member has an opportunity of taking part in a large proportion of the excursions These range from half a day to twelve days—and they study not only the taste but also the purse, while their scientific success should be assured when one glances at the names of the leaders Among the outstanding geological features to be visited are the Victoria Falls (with their fascinating physiographical history), the Bushveld Complex, the Karroo, the Great Eastern Escarpment of the Drakensberg at the Devil's Kantoor (the magnificent scenery of which has made this a classical spot for studying the tremendous physiographic contrast in the relationship between the Central Plateau and the coastal belt), the Zululand Cretaceous Beds, and the unique Vredefort Dome, where a central granite is surrounded by a girdle of sediments showing an inversion of the succession through thousands of feet of thickness, and associated with an almost incredibly intense metamorphism Through the published work of Molengraaff, Hall, and Nel, much detailed information on these extraordinary phenomena is available Of the various occurrences of alkali rocks, the programme provides a visit to the Franspoort bodies near Pretoria, the alkali granites and canadites round the Vredefort Dome, as well as the Pilandsberg (with its remarkable ring inclusions)—the largest alkali mass yet examined in detail, which has recently been described by Shand (*Transactions of the Geological Society of South Africa*, 1928)

Economic geology naturally has a prominent place in the programme the Kimberlite diamond pipes of Kimberley and the Premier Diamond Mine (whence came the largest diamond on record), the Witwatersrand with the world's most important goldfields, the primary platinum deposits of the Bushveld, the remarkably rich asbestos mines near Barberton, the rare chromite occurrences in the Bushveld Complex, the ore deposits and peculiar desert geology of South West Africa, including the mineralogists' well known hunting ground of the Tsumeb lead and zinc mines, and last, though certainly not least, the copper bearing regions of Northern Rhodesia, now recognised as a most important asset in the mineral resources of the British Empire

The Congress has also begun the practice of setting aside for special study the world's resources in certain types of ores—for example, iron, coal, pyrites—and the resulting volumes remain a handsome testimony to the foresight of the Congress No happier choice could have been made for the South Africa meeting than the subject of the "Gold Resources of the World"

The recent publication by the Geological Survey of the Union of a map on the scale of one in a million, also the latest volume (written by some members of that Survey) in the well known series of the "Handbuch der regionalen Geologie", dealing specifically with the Union, will be much appreciated by visiting geologists in particular For those who may want to take in a wider field there is the admirable volume by Du Toit on "The Geology of South Africa"

The almost simultaneous meeting in South Africa of the British Association, under the presidency of a distinguished geologist, Sir Thomas Holland and the useful measure of co operation with the Congress, arranged for at Johannesburg and Pretoria will render 1929 a memorable year in the history of geology, while the gathering of the world's geological clans in that sub continent may well repeat the truth of the well known phrase "Ex Africa semper aliquid novi" A L H

Obituary

THE MAHARAJ RANA OF JHALAWAR

THE announcement in NATURE of April 20 of the death of the Maharaj Rana Bhawani Singh of Jhalawar while again on his way to Europe recalls the fact that, of those with whom he was associated in previous visits, too many would not have been here to welcome him He would doubtless have missed especially Sir James Dewar at the Royal Institution, Prof A D Waller at the Physiological Laboratory in the top story of the University of London, Sir Archibald Geikie, president of the Royal Society at its 250th anniversary, which the Maharaj Rana attended as a delegate from India, and besides those, Miss K Stephen, principal of Newnham, in 1912, and the presidents of the meetings of the British Association, Sir William Herdman at Cardiff in 1920, Sir Edward Thorpe at Edinburgh in 1921

The Maharaj Rana's first visit to Europe in 1904 furnished material for a book of travel pictures, published in 1912, when he came to England for a long stay with a suite of court officials in attendance, among whom, the Pandit Shyam Shankar was indefatigable in providing opportunities for the acquirement of knowledge of the West and the diffusion of knowledge of the ways and customs of the East

Meteorology was one of the sciences that caught the Maharaj Rana's attention He became a familiar figure at meetings of the International Commissions for Maritime Meteorology and for Weather Telegraphy which were held in London in September of that year It was an interesting time, because telegrams from Iceland, wireless telegrams from ships, and an international code for gale warnings were on the agenda papers The Maharaj Rana acknowledged the courtesy of the Commissions by a stately dinner, at which, with other novelties, the members with their ladies were initiated in the parting ceremonies of garlands and attar of roses

A visit to Cambridge in the same year provided the experience of luncheon and the gardens at Newnham College, with an exchange of civilities

between potentate and student by the aid of hand cameras then dinner in a college hall and the cultured serenity of the combination room, so impressive as to suggest that two or three years at an English university would form the proper completion of the education of the heir to a throne In 1920 that idea found expression at Oxford Kumar Rajendra Singh, recently married to the daughter of the Maharaja of Vizianagram, went to Christ Church, and the Maharaj Rana enrolled himself at New College Apart from a short return home in 1921, he lived in Oxford for two years, but he was always to be found at the lectures of the Royal Institution The British Association, the Royal Sanitary Institute, the Royal Aeronautical Society, and again, whatever was going on at the Meteorological Office, engaged his attention, including another meeting of the International Commission for Weather Telegraphy His part in the many scientific meetings which he attended was mainly to listen and appreciate Conversation was favoured as a mode of expressing himself, rather than writing or speechmaking, in that and in his letters he was invariably alert and precise

The *Times* of April 15 gave a striking account of the character and achievements of the Maharaj Rana as a ruler Others will cherish the remembrance of a genial and enthusiastic student of Nature and art As a Rajput his traditions and reminiscences were of military prowess and achievements with the bow As one condoles with the new Maharajah on the loss of his father, it is impossible not to wonder what would happen if the Indian princes betook themselves to the conquest of the secrets of the Nature that surrounds them, if they should turn their swords into tuning-forks and their arrows into sounding balloons NAPIER SHAW

SWEDISH zoology has sustained a serious loss in the death of Prof Nils Johan Teodor Odhner, which occurred at Stockholm on Oct 29, 1928 Prof Odhner was born at Lund in 1879 Graduating at the University of Uppsala, he became lecturer in zoology at that University In 1914 he was nominated as professor of zoology in the University of Oslo (Norway), and four years later he became *Intendant* of the department of invertebrates in the State Museum of Natural History in Stockholm Prof Odhner's zoological work consists principally of systematic and faunistic papers on the Trematoda, upon which group of animals he had been for many years a leading authority He also devoted some time to the study of certain groups of Crustacea His activities were not, however, confined to zoological research His wide social interests and energetic contribution to the intellectual life of his country are manifested by the various official positions which he occupied—as a delegate to the League of Nations, president of the Sweden Finland Foundation, and vice-secretary of the Swedish Academy of Science As a speaker and writer he contributed much to the popularisation of his own branch of science

WE regret to announce the following deaths

The Right Hon the Earl of Rosebery and Midlothian, K G, K T, F R S, Chancellor of the University of London, who was elected to the Royal Society in 1886 under Statute 12, which permits of the election of persons who "either have rendered conspicuous service to the cause of science, or are such that their election would be of signal benefit to the Society", on May 21, aged eighty two years

M Emile Chaix, professor of physical geography at the University of Geneva, aged seventy four years

News and Views

THE most important legislation affecting the welfare of migratory birds, since the Migratory Bird Treaty Act of 1918 between the United States and Canada, was passed by the U S Senate on Feb 11, and signed by President Coolidge on Feb 18 This was the Norbeck Andresen Migratory Bird Conservation Act, which has been fought for eight years in eight sessions of Congress, and finally succeeded when the matter of a Federal license, to which objection had been taken, was omitted from the Bill The Act is a direct sequel to the Migratory Bird Treaty of 1918, for it was found that, useful as that Treaty had been, much of its potential value seemed likely to be lost if provision could not be made for a system of refuges or sanctuaries in the areas traversed by the birds in their migratory flights, and on their wintering grounds The purchases of such reserve areas demanded large sums of money, and it was to meet this outlay that the Federal license, which proved to be the stumbling-block of the original Bill, was proposed The difficulty of finance has been removed by proposed State grants Although the Act makes no appropriation, it authorises a schedule of appropriations amounting in all to some eight million dollars, and settling down after ten years to an annual sum of 200,000 dollars The first year's sum of 75,000 dollars is to be devoted to a survey of the area to determine the places best suited to become bird refuges, and, this completed, the selected areas will be purchased and henceforth guarded by an appropriate staff The American Game Protective Association, which has strongly advocated the proposals of the bill in its bulletin, *American Game*, is to be congratulated on the success of its campaign

A SPECIAL type of rubber made by the Expanded Rubber Co, Ltd, Wembley Park, and marketed under the trade name of 'Onazote', which appears to have many uses in science and technology, has recently been mentioned in the Press Onazote is essentially a very spongy form of rubber prepared by vulcanisation under high gaseous pressure, which is sometimes as high as a hundred atmospheres During the cooling process the pressure is gradually reduced, with the result that the occluded gas expands, forming pockets of air enclosed in thin rubber membranes Onazote can be prepared with a variety of physical properties by suitably varying the process of preparation In particular, it can be produced in a hard

form not unlike ebonite in external appearance, and in a soft pliable form In each case the fine cellular structure is of course retained

THE material has a remarkably low specific gravity of the order 0 076 to 0 102 (that is, it weighs 4½ 5 lb per cubic foot), and the hard variety is stated to be practically impermeable to water The soft form combines low density with high resiliency, and tests indicate that after the removal of the compressing load the sheets return practically at once to their initial thickness As may be conjectured from its physical nature, onazote has a very low thermal conductivity The value of this constant as measured on a sample at the National Physical Laboratory is 0 00008 gram calories per square centimetre per second for 1 cm thickness and 1° C difference in temperature between faces It is suggested that the material may have a variety of uses Its lightness and non absorbent properties render it suitable for life belts and floats, and its resiliency suggests its possibilities in making shock absorbers, cushions, and allied articles It is also claimed to be of use as a sound absorber for making silence cabinets and improving the acoustics of buildings The hard variety has electrical properties akin to ebonite but without the brittleness of ebonite

THE problem of distributing the white population of the British Commonwealth in the most efficient manner as between all its parts, is the object of the various schemes of Empire settlement which are included in the Report of the Oversea Settlement Committee for 1928 (London H M Stationery Office, Cmd 3308) Among the many problems on which the report touches is that of the checks on this desirable redistribution of population These are many, and include, in Great Britain, the industrial habits and townward bent of the population and its unfitness and unwillingness to settle on the land, the upward tendency of the standard of living, the effect of schemes of social insurance which tend to anchor population and decrease its mobility, and the fact that the spirit of emigration becomes evident when the population is prospering and not in times of adversity In the Dominions, there are also certain factors that check the flow of population from the home country The call for population does not necessarily bear relation to the conditions in Great Britain and the need for emigration The Dominions want mainly agricultural workers and, among women, domestic workers, while the need for emigration is chiefly among the industrial workers The growing tendency of all the Dominions to make a more and more vigorous scrutiny, in the interests of racial fitness, of all who wish to enter the territory, reduces further the flow of emigrants from Great Britain

THE first conversazione this year of the Royal Society was held on May 15 in the Society's rooms at Burlington House As usual, there were numerous exhibits and demonstrations representing recent developments in many branches of science, as well as instruments and photographs of historic interest Atomic physics does not easily lend itself to large scale demonstration, but Prof G P Thomson showed photographs from his work on the diffraction of electron waves, and Messrs Adam Hilger, Ltd, included in their exhibit one of Dr Jean Thibaud's X ray grating spectrographs for soft X rays Applied physics exhibits included an instantaneous visual direct reading radiogoniometer (Radio Research Station, Slough) Physiological apparatus included a moving iron oscillograph recording sensory nerve action currents (Mr Bryan Matthews), and a portable electrocardiograph (Cambridge Instrument Co, Ltd) Recent biological work was represented by exhibits of 'breaking' in tulips from the John Innes Horticultural Institution, plants toxic to insects (Rothamsted Experimental Stations), and several exhibits from the British Museum (Natural History) Prof W A Bone and Mr R P Fraser showed some remarkable photographs of flame propagation in gases, Sir Robert Hadfield specimens of various special steels, the Anglo Persian Oil Co an apparatus for the visual examination of oil being cracked under pressure, and so on Twice during the evening Dr R G Canti gave a kinematograph demonstration, consisting of consecutive series of photomicrographs, of living tissue cultivated *in vitro* The film showed the processes of cell growth in the normal and malignant tissue out wandering of fibroblasts and wandering cells, the various stages of cell division including migration of the chromosomes, cell degeneration, phagocytosis The last part of the film, which dealt with the fibroblast of the chick embryo under dark ground illumination, showed the internal structures of the cell

AT the Friday evening meeting of the Royal Institution on May 10, Prof A E Boycott gave a fascinating account of the genetics of the mode of twist of the shell in *Limnæa peregra*, and illustrative collections were also on view at the Royal Society soirée on May 15 In the majority of species of snails the twist of the spiral is dextral, but in a few it is normally sinistral In many of the normal dextral species sinistral varieties occur, and vice versa, and these unusual forms occur either as odd sporadic specimens or else as an established component of the population *Limnæa peregra* is normally dextral, and its sinistral variety is very rare—less than a dozen sporadic having been recorded In four ponds in England the population of dextral snails included a small proportion (5 per cent or less) of sinistrals Four of these sinistral individuals were used for experimental breeding work It was found that sinistrality is a simple Mendelian recessive which is inherited according to the usual plan, save that any change of twist imposed by crossing is delayed for one generation The snail inherits not its own twist but the twist of its offspring, and segregation is by broods and not by individuals All inheritance in *Limnæa* is, however, not maternal Albinism was found to be a simple Mendelian recessive, transmitted in a straightforward fashion Sinistrality and dextrality are characters of considerable importance, for the reason that in the Helices, which are incapable of self-fertilisation, copulation is impossible between the two forms The peculiar inheritance of shell twist

is due to the fact that this character is determined at the first division of the egg, soon after the entrance of the sperm, and the form of the division is determined by the constitution of the egg and the sperm does not effect it Albinism, on the other hand, is a character which is not expressed until much later in development, by which time the contribution of the sperm has become effective

The speech delivered recently by Sir Robert Hadfield, as chairman of Hadfield's, Ltd, contained many points of special importance and showed the advances which the steel firms of Great Britain, including his own, are making In connexion with the attempts now being made to foster a better spirit between employers and employed, it is of special interest to note that, so long ago as 1894, Sir Robert presided at a well attended meeting of employers and labour representatives in London, when a body was formed to which the name of the Industrial Union of Employers and Employed was given The body had objects in view of a similar nature to those now being formulated by the Melchett Turner conference, and met with strong approval from many men of a more far seeing character Sir Robert remarks that, Had the employers at that time taken the matter with the same heartiness, and given the same support rendered by the labour representatives to myself (the president) and the Council, I fully believe that this work would not have come to an untimely end and would have proved of great national benefit I believe that the organisation then proposed would have gradually grown in importance and that much of the trouble since experienced might have been largely avoided "

In speaking of scientific research in Great Britain generally, and especially of research with a possible technical bearing, Sir Robert Hadfield made the following important observation "It is most advisable that research work should be fostered in the various universities of Great Britain Whilst we all recognise the splendid work done by the National Physical Laboratory, which is an exceedingly important organisation, those local centres must not be overlooked when monetary grants are being allocated It is usually the local centres which best know the needs of the particular locality concerned There is no reason why subventions or grants, whether from Government headquarters in London or locally, should not be freely handed over to our various local universities, thus locally stimulating and encouraging research, which is more than ever important nowadays" Interesting remarks were also made concerning the growth of the induction melting of metals and the new heat resisting steels The advance made in the latter connexion is indicated by the example given of a steel heated to a temperature of 1200° C for 21 hours which, after that very drastic treatment, was scarcely scaled at all

On Tuesday, May 14, the Prince of Wales formally opened the North East Coast Exhibition at Newcastle upon Tyne This great industrial exhibition, representative of the life and work of the north of England, has been organised and built in less than two years on a commanding slope on the Town Moor, and will remain open until October Prominent features are the Palaces of Engineering and Industries, where the Tyneside manufacturers have made good use of the opportunity of showing the manifold activities of the industrialist corner of England The Prince of Wales, who went to the Exhibition after opening the new department for mining research at Armstrong College, congratulated the promoters on the general lay out, its aim, he said, "is to revitalise existing industries, to discover how they should be adapted, and, if necessary, improved" Scientific discovery linked with industry is well represented in the president of the Exhibition, Sir Charles Parsons, and it is in this direction that we must look for the adaptations and improvements visualised by the Prince of Wales and for new methods and new industries to enable the British Empire to maintain its place in the world's markets

The Federation of Lancashire and Cheshire Museums, founded in January 1928, has issued a first annual report, which summarises very briefly the aims and accomplishments of the Federation The object is the practical one of a more efficient museum service as between museums themselves and as between museums and the public, and the experiment will be watched with keen interest in the hope that it may contribute to the solution of the difficulties and staleness of the smaller local museums The means adopted have been periodical meetings of museum curators and members of their committees, where subjects of practical interest are discussed, and a scheme for the donation, exchange, or loan of specimens between the federated museums Twenty three, out of a possible of thirty eight museums in the two counties, have joined the federation, the meetings were reasonably well attended, and the exchange scheme has been made use of by thirteen museums There can be no doubt about the excellence of the federation idea, time will decide whether the museums themselves are enthusiastic enough and energetic enough to make it a success

The Imperial Bureau of Soil Science, one of the eight Bureaux the formation of which was recommended by the Imperial Agricultural Research Conference of 1927, commenced work on May 1 at the Rothamsted Experimental Station Sir John Russell, Director of Rothamsted, is also the Director of the Bureau, and Dr A F Joseph, lately Sudan Government Chemist, has been appointed deputy director The functions of the Bureau include the collection and distribution of all research work of importance on soils to the British Empire, the assistance of research workers in the prosecution of their investigations in whatever ways it can, the bringing together of workers from different parts of the Empire (either by correspondence or in conference) interested in the same subjects, and to supply information generally which may facilitate the work of soil experts in the development of agriculture It is hoped that before long the Bureau will be in close touch with all soil investigators

of the Empire, both at home and abroad, and that by means of information circulars and other methods, the results of studies carried on in one part of the Empire will be made available for all. Arrangements will also be made to supply information dealing with soil investigations in foreign countries, the results of which, owing to language or other difficulties, are not readily available.

The Bohemian Academy of Sciences has recently issued its *Bulletin International* for 1926, containing in its 628 pages résumés in English or French of the papers communicated to the Academy during that year. These communications number nearly fifty, and cover the whole field of mathematical and natural sciences and medicine, and many, especially those dealing with biology, are illustrated with photomicrographs and other well executed illustrations. This is particularly noticeable in the three coloured plates accompanying Dr. V. Breindl's studies of plasmodium, those with Dr. J. Wolf's investigation of the genesis of collagen fibres, and those of Prof. B. Němec and Dr. Milovidov on bacteria in plant and human tumours. There is a posthumous contribution from Prof. J. V. Daneš on the limestone physiography of the United States of America, and among a number of other geological papers are several by Dr. Petrbok on the stratigraphy of the Palestine palæolithic (the first containing 108 figures). In mathematics, Dr. V. Trkal has given a contribution to the dynamics of the neutral helium atom whilst the *Bulletin* also contains Dr. Sobotka's deductions of certain polar properties in conic systems. Chemical science is represented by papers on the radioactivity of potassium and rubidium (Miss Petrova), adsorption by colloidal carbon (Dr. Podronžek), the electrolytic estimation of bismuth (A. Jílek and J. Lukas), and a study of the pyrrolones (R. Lukeš).

The only railway line laid across South America is the one joining Valparaiso and Buenos Aires, traversing both Chile and Argentina. It provides an overland connexion 840 miles long between the Pacific and Atlantic Oceans. It skirts the extinct volcano of Aconcagua in the Andes, and its maximum altitude is about 10,500 feet. The section of the railway from Los Andes to Mendoza is called the Transandine Railway. It is laid for a combined rack and adhesion service and has a metre gauge. The operation of this railway was rendered very difficult in winter by snowfalls, often 20 feet deep, and by avalanches of rocks. This necessitated extensive protective works and galleries. Owing to the soft coal used, thorough ventilation of the galleries was also necessary. This, and the fact that the coal used had to be raised to an altitude of nearly two miles against gravity, induced the directors of the Transandine Railway, which belongs to a British company, to adopt electric traction. This enabled an increase in the speed and weight of the trains to be made. As the freight consists mainly of cattle from Argentina to Chile, and perishable fruit in the opposite direction, the increase in weight and speed has many advantages. A full technical account of this railway is begun in the *Brown Boveri Review* for April. This company, in conjunction with the Swiss Locomotive and Machine Works at Winterthur, constructed the combined rack and adhesion locomotives which are used. These are the largest locomotives of this type that have ever been built. The brakes required for these locomotives are quite as important as the driving gear. The brakes for the adhesion driving wheels are of the Westinghouse compressed air type. When the emergency rack brake is used the automatic brakes on both locomotive and train are applied simultaneously. The braking force on the rack sections at the wheel tread is 32 tons. The total continual electrical braking capacity is 456 horse power.

Many accessions illustrating the historical development of the sciences were made to the Lewis Evans collection of the Old Ashmolean during the past year. They include a valuable series of perpetual calendars in various materials, a set of bronze facsimiles of previously unknown surgical instruments used in Pompeii in the first century, several important microscopes from the Crisp collection, and a refracting telescope of great historic interest, namely, the instrument used by the greatest of Oxford's astronomers, James Bradley, who himself lectured in the Old Ashmolean from 1729 onwards. The fifth Annual Report, for 1928, in addition to recording other gifts, directs attention to the need for treating the outer stonework of the building, which has not been refaced since 1679, and mentions a feature of the year which should be of great advantage to the development of the collections, namely, the foundation of a Society of the Friends of the Old Ashmolean. Previous to the annual meeting of this Society on May 4, Prof. D'Arcy W. Thompson delivered a public address on "The Hellenic Element in the Development of Science", to which reference was made in our issue of May 11, p. 732.

The annual visitation of the Royal Observatory, Greenwich, will take place on Saturday, June 1.

At the anniversary meeting of the Royal Society of South Africa, held on Mar. 20, the following officers for 1929 were elected:—*President*, Dr. W. A. Jolly; *Hon. Treasurer*, Dr. L. Crawford; and *Hon. Secretary*, Dr. B. F. J. Schonland.

The Council of the Royal Meteorological Society has sent a message of congratulation and good wishes to the Society's honorary member, Prof. Hugo Hergesell, on the occasion of his seventieth birthday, which will occur on May 29. We understand that addresses of congratulation will be presented to the veteran director of the Lindenberg Observatory by learned societies and official bodies in Germany in recognition of his services to meteorological science and its application to aviation.

An International, Colonial, and Maritime Exhibition is to be held in Antwerp next year in celebration of the Treaty of Belgian Independence. The British Empire will be well represented and the Treasury has sanctioned an expenditure of £100,000 on the exhibit

The most important British shipping companies are to have displays in the British section, and manufacturers of equipment for ships, such as navigation instruments, etc, will be specially invited to exhibit

AN International Photography Exhibition, to be held at Gothenburg on Oct 15–31, is being organised by the *Goteborgs Handels och Sjofarts Tidning* No entrance fees and no charges for return of exhibits are made A special section of the Exhibition will be devoted to scientific photography Correspondence concerning this section should be addressed to Dr S E Ohlon The honorary secretary of the Exhibition is G F Ahlberg, International Photography Exhibition, Box 52, Gothenburg, Sweden

TOWARDS the end of last year a British committee representative of some twenty six engineering institutions and technical societies was formed to organise a party of British engineers to attend the World Engineering Congress to be held at Tokyo on Oct 29–Nov 22 and to secure papers for presentation at the Congress (NATURE, Jan 12, p 62) Seventy six papers have now been contributed dealing with railway and river engineering, strength of materials alloy steels, aircraft, petroleum technology, chemical engineering, coal cleaning town planning, illumination and photometry, etc It is anticipated that a party of thirty five to forty representatives of British engineering theory and practice will attend the Congress

THE Council of the Institution of Electrical Engineers has made the following awards of premiums for papers read during the session 1928–29, or accepted for publication The Institution Premium to Mr Johnstone Wright and Mr C W Marshall Ayrton Premium to Mr L G H Sarsfield, Fahie Premium to Mr A E Foster, Mr P G Ledger, and Dr A Rosen, John Hopkinson Premium to The Hon Sir Charles Parsons and Mr J Rosen, Kelvin Premium to Mr E B Wedmore, Mr W B Whitney, and Mr C E R Bruce, Paris Premium to Mr J L Carr, Extra Premiums to Capt J G Hines, Mr B L Goodlet, Mr L H L Badham, and Mr W Phœnix, Wireless Premiums to Mr T L Eckersley, Capt P P Eckersley, and Mr A B Howe, Mr R M Wilmotte and J S M'Petrie

AN expedition for the study of the behaviour of the mountain gorillas of Belgian Congo is announced in a recent *Daily News Bulletin* issued by Science Service, Washington, D C The expedition has been undertaken jointly by Yale University and the Carnegie Institution of Washington, by special arrangement with the Belgian government Dr Harold C Bingham of Yale, a psychologist who has already carried out extensive studies on the behaviour of apes in captivity, will be the scientific representative of the two American institutions He hopes to establish close and sustained contact with groups of mountain gorillas, to follow their movements day and night, and to observe their traits of behaviour in relation to species and varieties, their manner of life, and their distribution The expedition will leave the United States in June and proceed by way of Dar es Salaam to the head of Lake Kivu, whence a trek of a hundred miles will take the explorers into the gorilla country

THE fortieth Congress of the Royal Sanitary Institute is to be held at Sheffield on July 13–20, under the presidency of the Right Hon Earl Fitzwilliam, who will deliver the inaugural address on Monday, July 15 Sir Allan Powell, chairman of the Food Council, will deliver the Congress lecture, taking as his subject, "Some Aspects of the Food Problem", and Prof W W Jameson will deliver a popular lecture 750 delegates have been appointed by 430 authorities in the British Empire and other countries Among the subjects arranged for discussion are mental hygiene of the child and of the adult, health education, food hygiene, industrial welfare, smoke abatement, housing and regional planning, rivers pollution, and water supply The Right Hon the Lord Mayor of Sheffield, Alderman Harry Bolton, is the chairman of the local committee, and the Town Clerk, Sir William Hart, and the Medical Officer of Health, Prof F E Wynne are joint honorary local secretaries

APPLICATIONS are invited for the following appointments on or before the dates mentioned —A head master of the Junior Technical Evening Institute, Shelburne Road, Holloway The Education Officer (T 7), County Hall Westminster Bridge S E 1 (May 29) A teacher of building subjects at the Municipal Technical School, The Gamble Institute, St Helens—The Secretary for Education, 17 Cotham Street, St Helens (May 30) An assistant lecturer in electrical engineering at the Bradford Technical College—The Principal, Technical College, Bradford (May 31) A full time teacher in the Mechanical Engineering Department of the Lincoln Technical College—The Principal, Technical College, Lincoln (May 31) Temporary posts under the Department of Agriculture for Scotland, namely, two investigators and an indoor assistant for work in connexion with an inquiry into marketing live stock and other agricultural produce in Scotland—The Establishment Officer, Department of Agriculture for Scotland, Queen Street, Edinburgh (June 1) A woman resident lecturer in geography and mathematics at the Bangor Normal College—The Principal, Normal College, Bangor, North Wales (June 3) An assistant lecturer in the Mathematics and Physics Department, The Polytechnic, Regent Street — The Director of Education, The Polytechnic, Regent Street, W 1 (June 3) A lecturer in mathematics and a lecturer in physics at the University College of Swansea—The Registrar, University College, Singleton Park, Swansea (June 5) A principal of Brierley Hill Technical Institute, Stafford—The Director of Education, County Education Offices, Stafford (June 5) Research chemists at establishments of the Department of Scientific and Industrial Research—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, S W 1 (June 6) A junior assistant (engineer) at the Fuel Research Station, East Greenwich—The Secretary, Department of Scientific and Industrial

Research, 16 Old Queen Street, S W 1 (June 6) A headmaster of the Junior Technical School, Ashton under Lyne—The Education Office, 8 Warrington Street, Ashton under Lyne (June 8) Clothworkers' Research Scholarship in the Department of Textile Industries, the University, Leeds—The Clerk to the Senate, The University, Leeds (June 8) A lecturer in metallurgy and assaying at the Manchester Municipal College of Technology—The Registrar, Municipal College of Technology, Manchester (June 13) A lecturer in physics at Christ Church, Oxford—The Very Rev the Dean, Christ Church, Oxford (June 14) A lecturer and demonstrator in the department of physics of the Royal Holloway College—The Principal, Royal Holloway College, Englefield Green, Surrey (June 15) A lecturer in engineering and practical mathematics in University College, Dundee—The Secretary and Registrar, The University, St Andrews (June 15) Civilian education officers in the Royal Air Force Educational Service—The Secretary, Air Ministry, Gwydyr House, Whitehall, S W A junior assistant in the department of the War Department Chemist—The War Department Chemist, B 47 Royal Arsenal, Woolwich S E 18 A chief field officer of the Rubber Research Institute of Malaya—The Secretary, London Advisory Committee, Rubber Research Institute of Malaya, 2 Idol Lane, E C 3 A lecturer in mathematics at the Gordon College, Khartoum—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S W 1 (marked "Mathematics") Junior research assistants under the British Cotton Research Association—The Director, British Cotton Research Association, Shirley Institute, Didsbury, Manchester

Our Astronomical Column.

SOLAR STREAMS OF CORPUSCLES AND MAGNETIC STORMS —Prof S Chapman discusses the motion of streams of corpuscles from the sun in *Mon Not Roy Ast Soc* for March He uses Prof A E Milne's result that the Doppler effect will enable upward moving atoms to climb out of the absorption lines associated with them, and to be accelerated away from the sun The acceleration diminishes as the distance increases, so that for the greater part of the journey to the earth's orbit the motion is nearly uniform The time occupied is between one and two days, agreeing with the lag often observed after the passage of a spot over the central meridian of the sun before the arrival of the storm It is explained that, while individual atoms are moving nearly radially, the stream as a whole is rotating with the sun and so overtakes the earth, magnetic storms therefore begin near the sunset meridian of the earth It is estimated that the breadth of a stream when crossing the earth's orbit is of the order of 50 earth radii, in which case it would take twenty five minutes to sweep over the earth

The difficulty of explaining how the corpuscles can penetrate so deeply into the earth's atmosphere as to give rise to low level auroræ is dealt with The suggestion that these auroræ may arise from induced currents due to the corpuscles at higher levels is considered not to account for the definite forms of the auroral rays, it is thought more likely that the extrapolation used to obtain the resistance of air at extremely low density is at fault

FALL OF METEORITES INTO STARS —The presence of certain wide diffuse absorption bands which are well marked in the spectra of some stars, especially those of early type, was recently attributed by Dr H Shapley and Miss C H Payne to meteoric matter near the stars Later research, however, modified this view, and the glass of prisms or lenses was regarded as a more probable origin for these bands The latter conclusion is supported by theoretical considerations published by Prof H N Russell in the *Astrophysical Journal*, vol 69, p 49 It is shown that all meteorites (except abnormally large ones, more than 1 foot in diameter) will be completely volatilised before reaching the surface of the sun or a star The gas thus produced will scatter an amount of light dependent on the ratio of radiation pressure to gravity, and in this way might account for a small fraction of the coronal luminosity The total quantity of meteoric matter falling into the sun, however, cannot exceed 60 tons per second, and the maximum effective absorption produced (when radiation pressure nearly equals gravity) is not sufficient to produce the equivalent of a single narrow Fraunhofer line It is concluded that meteoric matter cannot account for perceptible bands in the spectrum of any star which is not surrounded by extremely dense nebulosity

THE SPIRAL NEBULÆ —New methods of study of the spiral nebulæ are being evolved with great rapidity at Mt Wilson The March issue of the *Proc U S Nat Acad Sci* contains papers by Dr E P Hubble and Milton L Humason, in which the radial velocities are studied and found to constitute a new criterion of distance Results for some of the brighter spirals had been obtained at Flagstaff many years earlier, and it was then found that there was a general tendency to motion of recession With the 100 inch reflector it has been possible to extend the research to fainter objects, and there is now sufficient material to apply statistical methods

It was found that those nebulæ which on other grounds were considered more remote gave larger motions of recession than those concluded to be nearer A solution was then made of the sun's motion with respect to the system of spiral nebulæ in which a K term was applied (the term being derived from that used for the systematic outward movement indicated by stars of our own galaxy), this was assumed to be proportional to the distance of the object The solution gave for the sun's apex the point R A 277°, N Decl 36°, velocity 280 km /sec, and K 500 km /sec per million parsecs Once this K term has been established, it can be used as a rough measure of the distance of remote nebulæ The largest recessional motion so far detected is that of N G C 7619, one of a small cluster of nebulæ on the border line between Pegasus and Pisces This is receding with a speed of 3779 km /sec, which becomes 3910 when corrected for the solar motion found above The distance estimated from the speed is 25 million light years, which is in good accord with the estimates from diameter and brightness

It is pointed out that, in de Sitter's cosmology, distant objects would show a recession increasing with remoteness, this is ascribed both to an apparent slowing down of atomic vibrations and to a general tendency of material particles to scatter, Dr Hubble expresses the hope that observations extended to more distant objects may make it possible to evaluate the amount due to each cause

Research Items

Modern Views on Life.—A reasonably stated view of the modern conception of life, by Prof. F. G. Donnan, appears in the May number of *Scientia* under the title "The Phenomena of Life". He points out that physiological investigation has shown much of the freedom and spontaneity of life to be more apparent than real. The living being neither destroys nor creates energy; it obeys the physical law of the conservation of energy. Nor is a living thing a magical source of free energy or spontaneous action; its life and activity are ruled and controlled by the amount of free energy in its immediate environment, and it lives and acts by virtue of this; that is to say, it obeys the so-called second law of thermodynamics. Yet there is more than this in life; the unit of living matter, the cell, builds up a whole which is greater than its parts. Whether the understanding of the specific finalistic manifestations of this whole will be explained on present day hypotheses or may demand the hypothesis of some new form of energy, the understanding will ultimately consist in something that permits of exact measurement and of precise expression in mathematical form, even though for the latter purpose a new form of mathematics may have to be invented.

Early Culture in Texas, U.S.A.—A recent examination of objects found in caves in the vicinity of El Paso, of which the importance lies in the indication of future lines of research rather than in actual results, is reported by Mr. F. H. H. Roberts, jun., in No. 7 of vol. 81 of the *Smithsonian Miscellaneous Collections*. Mr. Roberts first visited the caves some years ago while investigating the pictographs of the area, including those of the far-famed Hueco Tanks, an oasis, once a rendezvous of wandering bands of Apaches and travellers across the desert. Afterwards a large number of 'curios' were unearthed in the caves by two residents of El Paso. These, together with further finds from undisturbed portions of the caves, have been examined by Mr. Roberts in a recent visit. The pictographs in the caves belong to the group in the south-west to be attributed to the Apache, though a few of the older show Pueblo influence. Three of the figures are masked heads, and stepped structures on two of these may represent a framework similar to those of which actual fragments were found in the caves. The stepped form is comparable to Pueblo forms. Birds and snakes are readily recognisable, whether naturalistic or conventionalised. Among the objects of special significance found are woven sandals of fibre, spear shafts, curved clubs, a basket armlet with a crude setting of turquoise chips, abalone shell pendants, beads and a few fragments of pottery. The sandals are of a characteristically south-western type. The spear shafts, which are made of the flower stem of the agave, are coloured red and decorated with balls and streamers of agave fibre. Attached to them are small rods, similar to those found elsewhere, but the significance of which is unknown. The curved clubs are comparable to those of the Basket Makers' caves of north-east Arizona and south-eastern Utah. While it is clear that there is here an admixture of early and late, these objects indicate affinities with the Basket Makers, and it is suggested that the culture of the caves is the northern fringe of the Basket Makers culture of San Juan.

Curious Function of Gums in a Porpoise.—The remarkably small size of the teeth in the porpoises of the genus *Phocænoides* is well known. Gerrit S. Miller, having examined well-preserved specimens of the Alaskan species, *P. dalli*, is of opinion that the teeth are practically functionless and that their use as organs capable of grasping food has been taken by a curious development of the gums (*Proc. U.S. Nat. Mus.*, vol. 74, 1929). The gums are modified so as to form a set of secondary gum teeth, alternating with and surrounding the true teeth, which have come to lie at the bottoms of pits between the bases of the new structures, the size and hardness of which is such that they are undoubtedly capable of functioning as efficient grasping organs. The general condition shown in this toothed cetacean is similar to that of the early stages of development of the baleen plates of the whalebone whale *Sibbaldus*, where the true teeth have disappeared and gum teeth, compressed along the axis of the jaw, and increased in height, have formed. The resemblances are so important that the author considers that the gum and dental structures of the Alaskan porpoise represent stages of development closely parallel to those through which the corresponding parts in the toothed ancestors of the whalebone whales must have passed.

Encystment and Conjugation in *Pleurotricha*.—Reginald D. Manwell (*Biol. Bull.*, 54, 1928) describes encystment and conjugation in the hypotrichous ciliate *Pleurotricha lanceolata*, which has two macronuclei and two micronuclei. Encystment may occur at any time and appears to have no relation to periods of depression, to division, or to conjugation. Both macronuclei are extruded and only one micronucleus remains. It is uncertain whether the other micronucleus is always extruded or whether the remaining micronucleus is produced by the fusion of the two original micronuclei. From this one micronucleus the new nuclear apparatus is reconstituted, the process being complete by the time the ciliate is ready to leave the cyst. In conjugation there are three maturation divisions, an interchange of pronuclei and two, or rarely three, cleavage divisions. Of the four products of the second cleavage division one soon enlarges and gives rise to the new macronuclei of the ex-conjugant, one of the other products degenerates, and the remaining two form the new micronuclei. Reduction occurs in the second maturation division, the haploid number of chromosomes being probably twenty. "Conjugation appears to be not only an unnecessary part of the life cycle, at least as long as environmental conditions remain favourable, but is a very dangerous event, for 92 per cent of one hundred exconjugants died without further division, and only one per cent showed any indication of an accelerated fission rate," "and even in this case the daughter race died within a month."

Bitter Pit Disease.—Some recent investigations on the apple disease known as bitter pit, with practical information as to the chief means by which it may be avoided, are described by W. M. Carne in *Australian Journal for Scientific and Industrial Research*, vol. 1, No. 6. The disease came into prominence in Australia about 1900, and since 1911 has received the serious attentions of many scientific workers. Carne has now been able to elucidate the problem to a large extent. Picking tests with a number of varieties showed that bitter pit develops chiefly, if not entirely, in stored fruit and is thus quite distinct from cork, another disease previously known as bitter pit, but which develops on apples while on the tree. True bitter pit disease is caused by picking the fruit before it is sufficiently mature, large fruit being more susceptible than small. Although if picking is postponed too long the danger of over-ripeness during

storage is incurred, some greater delay than has been usual hitherto in the picking of apples for export will be beneficial, as not only will the liability of the fruit to bitter pit be reduced, but also a high quality in flavour and appearance will be ensured The correct date for picking can best be ascertained by means of the iodine method devised by Bigelow, Gore and Howard in 1905 The amount of starch in the apples as shown by the iodine reaction is definitely related to the amount of bitter pit disease, colour, and flavour afterwards developed after storage The method of testing consists in dipping cut halves of freshly picked apples into an iodine solution (potassium iodide 1 gm, iodine 0·25 gm per 100 c c water) for half a minute After a short exposure to the air the distribution of the blue colour is noted If the colour is almost or entirely absent the fruit is over mature for picking, but if scattered in small spots throughout the pulp outside the core line, the fruit can be picked with safety On the other hand, large patches of colour in the flesh indicate the necessity for allowing the apples to hang longer With practice other apples of the desired degree of maturity can be selected by eye This procedure assumes that the fruit will be placed in cold storage within a few days from picking

SOLANUM HYBRIDS —An account of crosses between *Solanum utile* and pollen from the domestic potato has been given by Salaman (*Jour Genet*, vol 20 No 3) The cross was only a success in 25 per cent of the 52 attempts, and the reciprocal cross could not be obtained at all Also, as a result of many trials, a single plant, indistinguishable from *S utile*, was obtained by pollination with *S chacoense*, and it bred true in the next generation In the crosses between *S utile* and the domestic potato several cultivated varieties were used as pollen parents, and with three exceptions giving the same result In the F_2 and later generations, whole families were indistinguishable from *S utile* in morphological characters, yet certain physiological and genetic differences can be shown by back crossing such as the presence of sterility and the incidence of disease Some of these families, while showing the low cropping capacity of *S utile*, are nevertheless carrying recessive genes for higher cropping, the inhibitory factors of *S utile* being dominant Other families were nearly, with some plants quite, indistinguishable from the domestic type The inheritance of the differences in leaf characters and cropping are particularly described

LEPTOCHILUS AND GENERA CONFUSED WITH IT — Following the modern tendency in taxonomy to seek a phylogenetic arrangement for all groups of plants, E B Copeland (*Philippine Journal of Science*, vol 37, No 4, December 1928) has published a revision of the African, Indian and Oriental species of the genus *Leptochilus* Six natural groups, each given generic status, are recognised *Leptochilus* is retained as a small genus of epiphytic ferns, the largest genus, *Campium*, consisting of terrestrial ferns with creeping rhizomes This genus receives monographic treatment, fifty six species—eighteen of which are newly described—being enumerated The study of the whole group is complicated owing to the involved nomenclature, and much attention is devoted to the determination of the proper generic and specific names The paper contains a large number of text figures showing details of frond venation in the species of *Campium*, and all new species and a number of old ones are illustrated by plates

CONIFERÆ —The identification of Conifers by means of their vegetative organs is the subject of an interesting paper which appeared recently in the *Scientific Proceedings of the Royal Dublin Society* (vol 19, N S 19) The author, Mr H M FitzPatrick, having in mind the difficulties that beset systematists when flowers and fruit are not available, has compiled a key to the genera and species of the Coniferæ, based on the morphology of the foliage There are certain difficulties inseparable from such an attempt, not the least of these being the diversity of foliage in juvenile and adult forms of the same species The nonconformity to type of recent introductions to cultivation, particularly species of *Abies* and *Picea*, create further complications Such a scheme of classification, to fulfil its purpose, must of necessity be an artificial one This does not detract, however, from its value for diagnostic purposes and in its construction Mr FitzPatrick has achieved a considerable measure of success Leaf shape and arrangement form the basis of the key to the genera, while its subdivisions rest on the prominence, or otherwise, of stomatal bands and midrib the woody nature of the second year twigs serve to distinguish the Abietineæ and Taxodium from all other Conifers For the recognition of species special keys are introduced, following, more or less, conventional lines In this connexion the use of variable features, pubescence for example, as specific indicators, though sanctioned by custom is open to question The ultimate definition of the species is materially assisted by a series of brief descriptions of their individual characteristics, supplemented by numerous illustrations, some of which, however, are unfortunately lacking in precision Notes on their economic uses and distribution form a useful adjunct to descriptions of the species The paper concludes with a short bibliography

GEOLOGICAL MAP OF MONT BLANC —A geological map of the French part of the massif of Mont Blanc is being issued by Paul Corbin and Nicolas Oulianoff on the scale of 1/20 000 The first sheet (Servoz les Houches) appeared in 1927 The second (Chamonix) and third (Les Tines) sheets have now been issued, and each is accompanied by a descriptive pamphlet (Imprimerie Librairie G Jacquart Price 20 francs) A general and detailed geological description of the massif is promised in due course The maps measure nearly 14 × 10 inches plus borders and legends, and the geological units and topographical base are clearly printed with excellent registration The Quaternary deposits are coloured in clear pale tints the older formations being given more vigorous colours so that they stand out clearly The lithological composition of the crystalline rocks is indicated by overprintings of points and lines on the fundamental colours In this way the major tectonic units are well brought out as well as the individual formations, sedimentary or igneous The maps may be recommended not only to professional geologists but also to those who may be holiday making in the Chamonix district and wish to know something of the rocks that are there displayed

THOLEIITES OF THE NORTH OF ENGLAND —Continuing their work on the igneous geology of the north of England, Prof Arthur Holmes and Dr H F Harwood have recently published a detailed account of the Tertiary tholeiite dykes (*Mineralogical Magazine*, March 1929, pp 1 52) Eight new chemical analyses are presented, and in addition to the Brunton, Talaidh, and Salen types already recognised by the Survey petrologists, Cleveland and Acklington types are distinguished, these referring typically to the rocks of the dykes well known under those names Although the whole suite of dykes appears to converge to a focus in Arran, it is shown that there is a regional

change of direction, as the suite traverses the Southern Uplands which carries it by way of Great Cumbrae and the Ayrshire coast into the Mull swarm of dykes Many of the dykes carry anorthite aggregates, and Teall's original hypothesis to explain their presence is supported A discussion of magmatic variation leads to the conclusion that differentiation by crystal lisation and separation of the residual liquors was not the process responsible for the production of the different types of tholeiites It is suggested that the variation may have been due to admixture with a Whin Sill type of magma of a quartz alkali felspar eutectic formed from sial by long continued contact with basaltic magma This is a return to a long despised conception first introduced by Bunsen to explain the igneous rocks of Iceland

Measurement of Nile Discharge Over a period of more than twenty years, observations have been made with the view of the establishment of an automatic and accurate measure of the discharge of the Nile throughout the year The last of four papers dealing with this subject is now published in Physical Depart ment Paper No 24 of the Ministry of Public Works Egypt in which Mr D A F Watt gives the final conclusions on the methods and the tables of results It has been found that during the low stage of the Nile there is no significant difference between the results given by sluice measurements at Aswan and current meters but that in flood time the current meters give results about five per cent too high or even more at the top of high floods Experiments with scale models which were described in a previous paper have been shown to be a useful means of inter polating results between the low stage and the floods when the discharge of the sluices is not known with the same certainty as at other times of the year The important conclusion is that the dis charge of the Nile at Aswan can now be measured with a high degree of accuracy by the means em ployed]

North Staffordshire Coalfields — The Depart ment of Scientific and Industrial Research has just issued as *Paper* No 14 of the physical and chemical survey of the national coal resources a description of the coalfields of North Staffordshire (London H M Stationery Office) This paper differs, and differs most unfortunately, from previous ones in the series inasmuch as the special work which the Fuel Research Division of the Department of Scientific and Industrial Research is specifically supposed to perform, namely, the physical and chemical investigation of the coals of Great Britain, is entirely absent from the present paper It contains merely a description of the North Staffordshire coalfield, such as is already obtainable elsewhere Indeed, it carries our information no further, if so far, as do the *Memoirs* of the Geological Survey It would surely have been better to wait until the physical and chemical investigation, which the Fuel Research Division is supposed to undertake, had been completed and then to publish this informa tion in the way that has been done in the case of the other coalfields, rather than to adopt this piecemeal method of issuing information, which, although it may at first sight lead to an appearance of great activity on the part of the Fuel Research Division, really shows that the proper work of that Division is not being pushed as it should be

Hall Effect in Nickel Steel Alloys —Interest attaches to the Hall effect as exhibited by the nickel steel alloys, since the rotations of the two components of these alloys are of opposite sign, and since, moreover, such alloys present peculiarities in their thermal and electrical conductivities which, according to the electron theory, are intimately connected with the Hall effect In the issue of the *Rendiconti* of the Naples Academy of Physical and Mathematical Sciences for May–August 1928, Dr Umberto Salerno communicates the results of measurements of this effect made with a series of steel nickel alloys contain ing different proportions of nickel The Hall effect observed exhibits the same characteristics as that of the ferro magnetic metals, and is influenced to some extent by the nature of the secondary electrodes em ployed The alloy known as invar shows a moderately high coefficient of rotation In all the alloys ex amined asymmetry is revealed, this being most marked with the alloy containing 22 per cent of nickel, which is the least magnetic and almost zero with that having 49 per cent, which is highly magnetic The contribu tion of the steel to the Hall effect is more pronounced than that of the nickel 80 per cent of which is necessary to cause reversal of the sign The variation of the effect with the composition presents analogies with the corresponding variations of the specific heat, thermo electric properties thermal conductivity and electrical resistance

The Triple Point of Water —The usual specifica tion of the zero of the centigrade scale of temperature in terms of the melting point of ice, although very con venient for most purposes, is somewhat unsatisfactory because of the difficulty of reproducing exactly the standard conditions of measurement In particular, the effect of the air which dissolves in the water used is a little uncertain and the German Physikalisch Technischen Reichsanstalt has therefore had under consideration the advisability of replacing the present fixed point by the slightly higher triple point of water A report of the experimental work that has been done in this connexion has been published by H Moser in a recent issue (No 3) of the *Annalen der Physik* It has been found that the temperature recorded by a platinum resistance thermometer can be held constant to one ten thousandth of a degree when it is controlled by a bath containing pure ice, water, and water vapour in thermal equilibrium Subsidiary measurements established that the freezing point was lowered by 0 0074° C from this when the ice was in contact with air free water at a pressure of one atmosphere, so that with an allowance of a further 0 0024° C for the lowering of the freezing point when the water is allowed to dissolve air to equilibrium, in accordance with the Reichsanstalt specification of the zero point, the temperature of the triple point becomes + 0 0098° C The triple point of water is at the present time the most nearly constant fixed point of the temperature scale

Analysis of Phosphoric Acid —A detailed study of the determination of phosphoric acid as magnesium pyrophosphate is described by M Ishibashi in the *Memoirs of the College of Science, Kyoto*, vol 12, No 1 The effects of the composition of the magnesia mixture used, of the acidity of the solution, and of the presence of various salts and acids, were examined, and the conditions for maximum accuracy determined A method was developed for the quantitative pre cipitation of phosphoric acid as manganous ammonium phosphate, the formation of manganous acid being prevented by the addition of a small quantity of hydroxylamine hydrochloride The manganese in manganous ammonium phosphate can be exactly titrated with potassium permanganate In a third paper, a new gravimetric method is described for determining phosphoric acid as zinc pyrophosphate, and in this case the zinc may be titrated by an oxalate method

The New Department of Zoology of the University of Edinburgh

FOR many years past the accommodation in the Department of Zoology at Edinburgh has been inadequate to meet modern needs and to cope with the number of students studying the subject In 1923 the late Mr Laurence Pullar of Bridge of Earn visited the Department and was deeply impressed with the adverse conditions he found Mr Pullar who had long been sympathetically interested in zoology more particularly in those branches of it that occupied the attention of his friend the late Sir John Murray made a donation of £20 000 towards the erection of new laboratories His much appreciated gift remained anonymous until shortly before his death in 1926 In the same year the Trustees of the Carnegie Trust for the Universities of Scotland in their allocation of grants for the quinquennium 1925–30 set aside a sum of £18 000 Prof Augustus Trowbridge of Princeton University then director for Europe of the International Education Board paid an unannounced visit to the Department in 1926 and inquired into its needs and financial position As a result of this and with his sympathetic co operation Prof J H Ashworth was enabled to draw up a statement of the requirements The Board saw its way to give £74 000 for the completion of a building for equipment endowment and addition to staff and technicians

Prof Ashworth drew up sketch plans which were placed in the hands of Sir Robert Lorimer and Mr J Matthew and work was commenced in June 1927 The building was formally opened by H R H Prince George on May 15 last in the presence of the Vice Chancellor a large number of representatives of the national and civic authorities and of zoologists from other universities In his speech Prince George referred to the traditions of the Department the chair of which was founded in 1770 and to the importance of zoology and its many applications to the welfare not only of Great Britain but of the whole Empire The need for trained zoologists, particularly overseas, at the present time is great The building is the second of a new group known by permission as the King s Buildings and Prince George expressed his pleasure at learning that through the munificence of various donors private and corporate other buildings were soon to be erected on the same site forming part of a scheme for the expansion of the University He congratulated the architects upon their success in combining pleasing effect with utility

Photo From Cairds Inglis

FIG 1 —The new Department of Zoology of the University of Edinburgh

After the opening Prince George was invested with the honorary degree of Doctor of Laws made a tour of inspection and attended a luncheon in the Old University buildings The University O T C mounted a guard of honour

The new building (Fig 1) is of sandstone from the Blaxter quarry and consists of a central part with a larger wing facing north and a smaller one facing north east its total length is 287 feet It is two storied for the greater part but the fall of the ground allows of a well lit basement under the east wing Between the large windows in the upper and lower stories are a number of panels with oval medallions about 4 ft 6 in long bearing representations of a series of animals They are arranged in sequence and chosen to represent the main zoogeographical regions They are the work of Miss Phyllis Bone who also furnished for the lintels above the first floor windows smaller round medallions of three animals well known to ancient naturalists the scarab the crab and the octopus

Throughout the whole building the most emphasised feature is the provision of the maximum amount of light The museum which is for teaching purposes

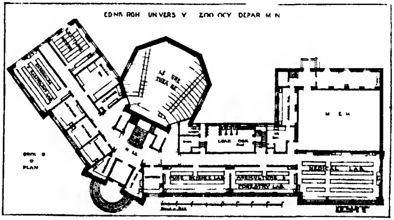

FIG 2 —Plan of ground floor

is 55 feet long by 40 feet wide with a 10 foot gallery along one of its long sides under which is a well equipped aquarium The main museum is lit by a cupola and the gallery by an oblique roof light, and in both is a new type of glass devised by Sir Herbert Jackson in conjunction with Messrs Chance It is designed to exclude the ultra violet and strong actinic rays and at the same time provide a maximum transmission and diffusion of direct sunlight The library is furnished with enamelled steel shelving gallery stair, and stack room and has an initial accommodation of about 8000 volumes, which should

form an adequate reference collection The large lecture theatre, occupying most of the central part is of octagonal form, has a specially constructed diagram screen, and provides 318 separate seats, the two smaller theatres for advanced and post graduate students each accommodate about 50 The laboratories and research rooms on the two wings are laid out as a series of units 15 feet wide by 16 feet deep, and the inclusion of several units gives laboratories of the sizes required for all the different classes The Department has, besides the laboratories for the staff, technicians rooms, workshop, etc, eight separate research rooms each for one worker, and a larger room which would accommodate two to four workers

The total cost of the building has been £80,000, and it is felt that with its modern equipment and design it provides adequate facilities for teaching purposes and for the various lines of research that are now being carried on or are likely to be undertaken for some years to come Two main objects have been kept in the forefront of all the designing, first, fitness for purpose, and secondly, the utilisation of standard units which permit of the maximum amount of interchange and therefore flexibility

Forest Insurance

IN *Special Bulletin* No 179 (September 1928), issued by the Experiment Station of the Michigan State College of Agriculture, Mr Paul A Herbert discusses "Forest Insurance and its application in Michigan The greater part of the author's thesis is devoted to the great forest problem in the United States of fires and fire protection, and the consequent higher rates demanded for insurance on forest property exposed, as is the case in America to this peril Mr Herbert cites the more or less successful efforts at forest insurance attempted in European countries, which had their origin in France and Germany in 1880 Norway in 1912 Finland since the Armistice, in Belgium, Holland Denmark in the late years of last century, and finally in Sweden since 1919

In treating of ordinary insurance as against insurance against forest fires, the author points out as one of the difficulties that annual returns are not obtainable in the younger stages of a forest, and therefore the private owners of land do not consider that forestry can compete with other productive enterprises He rightly concludes that the reluctance of landowners to take up forestry as a business undertaking is based mainly on general questions of the risks, the rate of tree growth, and rough calculations as to future costs and prices It may be admitted that investment in the forestry business will not usually bring in the early returns obtainable from other enterprises, whilst the risks are in some respects greater

The methods often suggested in order to assist the private landowner to make forestry a paying business are more equitable taxation, government assistance, and better protective methods These coupled with an anticipated future increase in the price of timber and other forest produce, would, it is held, make private forestry a paying business These factors would tend to decrease the cost of production or decrease the risk to which the invested capital is exposed

On the subject of taxation of woods, the usual remedy suggested is deferred taxation on lands occupied by woods The chief advantage of this method would lie not in reduced costs, but in reduced risks, and would allow the timber grower to estimate his future taxation in this respect If any accident happened to the crop or impaired its value the taxes would automatically be reduced Government assistance the author considers, should be mainly confined to paying for research work which is beyond the power of the private owner to undertake, whilst the third remedy, protection, involves decreasing the risks and therefore improving the property from an insurance point of view

The keynote of the author's discussion is the reduction of risk by effective protection, thus facilitating insurance of the property Such insurance, by eliminating further risks and losses, will place forestry on a business basis The capitalist', says Mr Herbert, will find the profits obtainable are large enough to be attractive in view of the reduction of uncertainties The investor will consider the insured forest as sufficient security to warrant lending funds to the business at the usual rate of interest" The whole crux of the business in many countries, both in the past and the present, is bound up with the methods in force in land taxation which often do not sufficiently distinguish between land from which an annual return is obtainable and that from which the returns are deferred for long periods, as is the case in forestry

University and Educational Intelligence

CAMBRIDGE —Dr D Stockdale, fellow of King's College, has been appointed University demonstrator in the Department of Chemistry

LONDON —The result of the Convocation elections to the new Senate of the University of London—a general election following the new Statutes—was announced at the meeting of Convocation on May 14 In the Science Faculty there were eleven candidates for five seats, the successful candidates being Dr C W Kimmins with 1018 votes, Prof F G Donnan, 934, Sir Philip Magnus, 889, Dr R H Pickard, 847, and Mr G D Dunkerley, 835 The unsuccessful candidates were Prof Winifred Cullis, 806, Dr G T Morgan, 783, Sir Llewellyn Smith, 544, Mr W A W Dagger, 426, Mr T Ll Humberstone, 354 and Mr A E Evans, 307 In the Arts Faculty the old members were re elected, with the addition of Prof T P Nunn In Engineering, Mr Roger T Smith and in Economics, Dr W H Coates were elected both being new members of the Senate The representatives of faculties include the following — Faculty of Medicine Lord Dawson of Penn, Dr H L Eason, and Sir Cuthbert S Wallace, Faculty of Science Prof A J Allmand, Prof L N G Filon, Dame Helen Gwynne Vaughan, and Prof Frank Horton Faculty of Engineering Prof S M Dixon and Prof E H Lamb, Faculty of Economics (including Commerce and Industry) and Political Science Prof T E G Gregory

MANCHESTER —Applications are invited for the Edmund Mills Harwood memorial scholarship, value £50 per annum for three years, at the Manchester Municipal College of Technology Forms of application and all information are obtainable from the Registrar of the College The latest date for the return of completed forms is June 15

ST ANDREWS —The University Court has appointed Dr Frederick Walker, at present assistant in geology, to be a lecturer in geology as from the beginning of the next academical year

LIKE so many other professions, that of surveying grows more important, complex, and difficult Old rules of thumb and hastily formed opinions can no longer be applied If, among the surveyor's essential

qualifications, mathematics and a wide knowledge of central and local government are added to those divisions and subdivisions of his practical work, it becomes clear that the old method of apprenticeship is quite inadequate Such points were emphasised by Mr B W Adkins in a paper on the education of the young surveyor which he read, on April 8, before a general meeting of the Surveyors' Institution Mr Adkins showed how the system of examinations and other facilities of the Institution have met these changes and made it possible for the profession to be supplied with qualified practitioners Tracing some present weaknesses, he said that if a boy leaves school at sixteen or seventeen and decides to be a surveyor, he finds that he cannot take the intermediate examination for several years During the interim, although serving articles, he frequently loses the habit of study, since he is free from school discipline and has no immediate spur towards theoretical work To meet this difficulty and to ensure continuity of study, the Institution has decided to adopt recommendations which will enable the future surveyor to take the more elementary part of the intermediate examination before the age of nineteen Mr Adkins considered, too, that the recent introduction of a compulsory preliminary examination will remedy other weaknesses such as bad spelling, indifferent English, and lack of accuracy and method Mr Adkins' belief in the work already done by examinations and their future possibility was very definitely expressed "There have been numerous attempts to discredit the examination system I am confident that, if properly devised, a system of examination is the best method of inducing young men to acquire such knowledge as is necessary for their progress"

THE Committee of Award for the Commonwealth Fund Fellowships has made appointments to twenty four fellowships tenable by British graduates in American universities for the two years beginning September next These include Mr Eric Ashby (London) to Chicago, in botany, Mr Geoffrey Crowther (Cambridge) to Yale, in economics, Dr H J Emeleus (London) to Princeton, in chemistry, Miss G H Faulkner (Edinburgh) to Chicago, in zoology, Mr W L S Fleming (Cambridge) to Yale, in geology, Mr V S Forbes (Cambridge) to California, in geology, Mr J N Goodier (Cambridge) to Michigan, in structural engineering, Mr A Harvey (Durham) to California, in physics, Mr R C Hinton (London) to Cornell, in economics, Dr W G Humphrey (Oxford) to Harvard, in chemistry, Mr W R Humphries (Aberdeen) to Columbia, in education, Mr J W Maccoll (Glasgow) to California Institute of Technology, in engineering (aerodynamic), Mr H L Puxley (Oxford) to Yale, in economics, Mr D M Robinson (London) to the Massachusetts Institute of Technology, in electrical engineering, Dr A F Skinner (St Andrews) to Columbia, in education, Mr E T C Spooner (Cambridge) to Harvard, in medicine, Mr A J Watters (St Andrews) to Wisconsin, in organic chemistry, Mr J H C Whitehead (Oxford) to Princeton, in mathematics, and Mr R van de R Woolley (Cambridge) to the California Institute of Technology, in astronomy Fellowships tenable by candidates from the British Dominions include Mr H. Barak (New Zealand and Oxford) to Princeton, in physical chemistry, Mr H. V Warren (British Columbia and Oxford) to the California Institute of Technology, in geology The following have been appointed to fellowships tenable by candidates holding appointments in government service Mr Eric J Bradshaw (Dublin) of the Geological Survey of India, Mr R M Campbell (New Zealand) of the New Zealand Civil Service, Mr A. H Crane (Adelaide) of the Queensland Forestry Service

Calendar of Patent Records

May 26, 1733—The patent granted to John Kay of Bury on May 26, 1733, covered the invention of the fly shuttle, perhaps the most important improvement ever made in the loom It revolutionised the weaving industry and rendered the power loom possible But it left Kay a poor man The last we hear of him is in 1766, when he appeared before a Committee of the Society of Arts, and he must have died soon after, probably in France, where he had tried to obtain the recognition that he failed to get in his own country

May 26, 1798—The principle of the hydraulic ram was first used for raising water by John Whitehurst of Derby, who applied it to a domestic water supply in such a manner that every time the tap was turned on and off in the kitchen, a column of water was forced into a tank in the upper part of the house Whitehurst sent a description of his apparatus to the Royal Society in 1770, but its value as a water raising machine was not recognised until an improved self acting type was invented by Joseph Michel Montgolfier and patented by him in France on May 26, 1798 An English patent was granted in the preceding year to Matthew Boulton acting as Montgolfier's agent

May 29, 1624—The first legislative enactment for regulating the granting of industrial monopolies was the Statute of Monopolies (21 Jac I c 3) passed by the English parliament on May 29, 1624 The Statute was not, as has often been assumed, the foundation of the English patent law, it merely gave parliamentary sanction to principles which had long been accepted at common law Its purpose was to prevent the Crown from granting oppressive monopolies, but in the famous Section 6 it exempted from the general prohibition the granting of patents for the encouragement of new inventions This section is still in force

May 29, 1849—David Smith of New York was granted an English patent on May 29, 1849, for an improved shot tower for making small shot, in which the fused metal falls through an ascending current of air, a process which enabled a much shorter tower to be used

May 31, 1836—There were many inventions before this date for the use of the screw propeller in steam navigation, but credit for its practical introduction is mainly due to Francis Pettit Smith, whose English patent is dated May 31, 1836 Pettit Smith's invention, first tried on a small 10 ton 6 h p vessel which was successfully run on the Thames and afterwards at sea, was, at the request of the Admiralty, fitted to the *Archimedes* of 237 tons and 80 h p, which attained a speed of 10 miles per hour Smith realised little from his invention, but he was given a civil list pension of £200 a year and in 1871 received the honour of knighthood For the last thirteen years of his life he was the curator of the then Patent Office Museum

June 1, 1869—Thomas Alva Edison's first patent was granted in the United States on June 1, 1869, for an electrical apparatus designed "to record and register in an instant and with great accuracy the votes of legislative bodies," each member having a switch in front of him by moving which he could have his name impressed electrically under either the affirmative or negative votes Edison's output of inventions has been enormous, the United States patent records showing that for upwards of forty years patents have been granted to him at the rate of about twenty-five a year, the greatest number in any one year being seventy five in 1882

Societies and Academies

LONDON

Geological Society, April 24.—**Robert Murray-Hughes**: The geology of part of North Western Rhodesia, with petrographical notes by **A. A. Fitch**. The area lies approximately between lat. 14° and 17° S. and long. 24° and 30° E., and falls into three natural divisions, from west to east. The first is the flat, somewhat swampy country overlaid by the Karroo and Kalahari rocks; the second is the old peneplain surface forming the plateau of Northern Rhodesia and underlaid by the Transvaal and Pretoria rocks, and those of the Swaziland System; and the third, a deeply dissected country overlaid mostly by the Swaziland rocks and drained by the Zambezi and Luangwa rivers. The rocks are described and correlated with the Transvaal and Pretoria Systems of the south. The covering of sand in the west, together with certain 'ancient laterites', is correlated with the Kalahari System. The principal structural features are: (1) North-east and south west foliation caused by the intrusion of the Older Granites; (2) north west and south east fracturing caused by the intrusion of the Hook Granite; (3) graben faulting, which forms a part of the Great Rift Valley; (4) folding of the Karroo Beds.

Royal Anthropological Institute, April 30.—**J. H. Driberg**: Gala colonists of the sixteenth century. Analyses the varying incidence of Hamitic influence on the different Bantu tribes of the Lake region. Two immigrant cultures, the first of Gala origin *circa* 1600 to 1680, the second represented by the Bahinda dynasty and possibly referable to Lake Chad. Linguistic and cultural evidence for the Gala hypothesis. That the focus of this Hamitic culture lies to the west of Lake Victoria indicates that the immigrant route was via Mongalla and Wadelai. Traces of Gala influence are to be found among the Lerya, where it is linguistic, and among the Bari, where it is cultural, the present serf class representing the descendants of Gala invaders overthrown by a Bari rising. Nilotic and Nilo Hamitic convulsions due to Gala intervention during the fifteenth and sixteenth centuries, as revealed by a comparison of Nilotic and Bantu genealogies. The southward expansion of the Gala towards the Tana valley, the inception of a militant policy against the Abyssinians, and their colonisation of the cattle breeding countries round Lake Victoria, should all be correlated.

Society of Public Analysts, May 1.—**R. S. Morrell** and **S. Marks**: The determination of organic peroxides. A modification of Fahrion's method of determining the peroxide oxygen in oxidised linseed oil by measuring the iodine liberated from potassium iodide in the presence of sulphuric acid has been devised.—**J. W. Croxford**: Differential halogen absorption of oils and fats. Toms's bromine vapour method of determining the halogen absorption of oils gives rapidly the true iodine value of oils and fatty acids which require very many hours for complete absorption of the Wijs' reagent. Fatty acids and oils of the oleic acid series with the double bond adjoining the carboxyl group may thus be recognised. Iso oleic acids formed in the hydrogenation of oils, and the petroselinic acid of parsley seed oil, give similar results by the two methods, and have thus the double bond at a distance from the carboxyl group.—**W. R. Schoeller** and **C. Jahn**: A new method for the separation of small quantities of tantalum and niobium from titanium. The solution containing the oxalates is treated with sodium salicylate, which converts the titania into a stable crystalloidal sodium titanylsalicylate. The earth acids are then precipitated with calcium chloride, and finally precipitated with tannin.—**H. R. Ambler**: The analysis of small samples of gas. Apparatus for the analysis of small samples of about 1 c.c. of gas, in which rubber connexions are abolished.

DUBLIN

Royal Dublin Society, Mar. 26.—**J. Reilly, P. J. Drumm**, and **C. Boyle**: The production of essential oils from Irish grown plants (Part 5). Oil of dill.—**M. Grimes**: A study of lactose fermenting yeasts found in milk, cream, and butter. The yeasts examined consisted of two types. Type *A*, similar to, or identical with *Torula lactosa*, Harrison, isolated from Canadian cheese; type *B*, similar to, or identical with *Torula cremoris*, Hammer, isolated from yeasty cream.—**J. H. J. Poole** and **A. J. Clarke**: The effect of strong electric and magnetic fields on the rectilinear propagation of gamma rays. Sir J. J. Thomson has suggested that, since electrons show some of the characteristics of very high frequency wave trains, very hard gamma rays may possess some of the properties of charged particles, and he conducted some trials on a possible bending of a gamma ray beam in a dielectric exposed to a large transverse electric field. His results, on the whole, were negative. The present paper describes further trials, not only with electric, but also with strong magnetic fields. No effect in either case could be detected.

EDINBURGH

Royal Society, May 6.—**G. N. Hunter**: Colour sensitivity. In *Proc. Opt. Convention*, 1926, Dr. Houston described a new method of testing for colour blindness. The apparatus was purposely made insensitive by keeping the two colour patches under comparison 8 mm. apart. In the present research, these patches have been brought into juxtaposition, resulting in a great increase in colour sensitivity, estimated at 1000 per cent.—**E. B. Ludlam** and **R. B. Mooney**: The influence of air and moisture on the 'Budde effect' in bromine. The absence of expansion of pure dry bromine when exposed to light is explicable by calculating the rate at which the energy received can be taken up by the walls of the vessel; a film of moisture may prevent the re combination of bromine atoms on the surface and thereby retain the energy in the body of the gas. Air present in the gas may facilitate transfer of energy and cause expansion. There is no evidence of re radiation of energy.—**A. C. Stephen**: Studies on the Scottish marine fauna. The fauna of the sandy and muddy areas of the tidal zone. The density per unit area has been investigated. Parts of the Firth of Clyde (more than 3000 per square metre) and St. Andrews Bay, West Sands, are areas of exceptional abundance. The various species are not uniformly distributed over any beach, but either occur, or have their maximum density at, some particular level. On sandy grounds *Tellina tenuis* and *Nephthys cæca* predominate, on the muddy grounds *Cardium edule* and *Macoma balthica*.—**G. Redington**: Effect of diurnal periodicity on plant growth. By growing plants entirely in electric light, it is shown that a daily dark period is not essential, but with practically all the very diverse species grown, better plants were ultimately produced in 16 hours' light per day than in continuous light. Generally, poor growth was made in a light exposure of 8 hours' daily. The effect of the several physiological processes concerned upon the conditions obtaining at the apical meristem is considered in relation to cell formation and cell elongation.—**Margery Knight**: Studies in the Ectocarpaceæ (2). *Ectocarpus siliculosus*. Plants

collected from the Mediterranean coasts show a simple type of life history in which the plant body is haploid and reproduction is effected by the union of gametes produced in plurilocular sporangia The dominant soma of the British plants is, however, diploid and the zoids from plurilocular sporangia on these plants are already diploid and germinate immediately into new plants, sexual reproduction is achieved by zoids from unilocular sporangia Alternation of generations and sex differentiation are also discussed —**Mary H Latham** Jurassic and Kainozoic corals from Somaliland This collection of fossil corals from British Somaliland was made by Mr R A Farquharson Government Geologist, during his survey of the country in 1923–24 It includes Jurassic, Eocene Oligocene, and one Pleistocene specimen Most of the specimens are Eocene and were collected mainly in eastern Somaliland but some specimens from Deberaweina in western Somaliland have been identified as Eocene That district has not hitherto yielded Eocene corals There are three new species of *Astrocœnia*, all of which have large corallites and greatly resemble *Stephanocœnia*, and a new species of *Cyathocœnia* There is also a new genus, *Tubicora*, belonging to the *Goniocoridæ* The Oligocene corals include new species of *Stylophora Circophyllia*, *Favia Orbicella*, *Columnastræa*, and *Porites* The older faunas have Mediterranean affinities —**Sydney Goldstein** The asymptotic expansion of the characteristic numbers of the Mathieu equation

PARIS

Academy of Sciences, April 15 The president announced the death of M Gayon, *Correspondant* for the Section of Rural Economy —**P Séjourné** The railway from Casablanca to Marrakech The branch line for phosphates This line, 245 km long, was commenced in 1916, the discovery of rich phosphate deposits at Kourigha led to an alteration of the plans and the construction of a branch line 83 km long (150 km from Casablanca) Details of the phosphate deposits are given these deposits are remarkable both as regards high percentage of calcium phosphate and quantity available —**Emm de Margerie** Second report on the publication of the œuvres géologiques de Marcel Bertrand' —**V Romanovski** Some new classes of orthogonal polynomials —**M de Franchis** A recent theorem concerning quadrics —**Hadamard** Remarks on the preceding communication —**Rolf Nevanlinna** Remarks on the lemma of Schwarz —**Lucien Féraud** The Pfaffian systems of M Birkhoff —**G A Mokrzycki** The maximum utilisation of commercial aeroplanes —**Antonio Cabreira** The theory of a terrestrial metric planosphere —**Benjamin Jekhowsky** The identification of the minor planets and the correction of their orbits from a single observation —**J E Verschaffelt** The equation of Van der Waals and thermodynamics Reply to criticisms by V Karpen —**Quevron** The increase in the sensibility of electrical measuring apparatus with pivots The permanent magnet in the instrument is replaced by an electromagnet The power required is 150 watts, giving a magnetic field of 4500 gauss With this instrument it is possible to measure by direct reading 10^{-8} ampere or 10^{-3} volt Possible applications are discussed —**J Cabannes** The secondary radiations in light diffused by Iceland spar —**H Jedrzejowski** The groupings of radioactive atoms —**L Wertenstein** The β recoil —**André Chrétien** The ternary system water, sodium sulphate, sodium nitrate —**H Parent** The existence in Provence of a shore line at 6 metres, of recent Quaternary age.—**Henryk Arctowski** and **Edward Stenz** The origin of the dusts which fell in Poland between April 26 and 29, 1928 Proofs that the dusts which fell in Roumania and Poland on the above days originated in central Ukraine —**Joseph Devaux** The actinometric study of the penetration of the solar energy flux at the interior of some Pyrenees glaciers When the solar radiations penetrate the mass of glaciers, with the ice at 0° C, the absorbed energy produces a partial fusion of the ice, especially at the surface which becomes porous This porous condition reduces the transparency of the ice to the rays resulting in less penetration and less melting This process the author terms the radiothermic defence of glaciers —**Yossifovitch Mladen** The mechanism of the separation of the perithecium in the Erysiphaceæ and the rôle of the fulcra —**A Maige** The rôle of the cytoplasm in amylogenesis —**Lucien Daniel** The resistance to cold of the descendants of *Artemisia Absinthium* grafted on *Chrysanthemum frutescens* New varieties of absinthe plants, produced from seeds resulting from grafting Absinthium on Chrysanthemum, have proved very resistant to cold At the temperature of Rennes last winter (−21° C), numerous species regarded as acclimatised to the winter have been severely affected but the Absinthe arising from the grafts have survived —**H Lagatu** and **L Maume** The leaf diagnosis and its degree of security —**J Vellard** The properties of the cutaneous secretions of some tree frogs (*Hyla*) from the neighbourhood of Rio de Janeiro The toxicity of these secretions is as frequent in the group of Hylidæ as in other species The toxic characters vary greatly with the species —**R Fosse** and **A Brunel** The ferment producing allantoic acid by the hydrolysis of allantoin Its presence in the animal kingdom A ferment capable of giving allantoic acid from allantoin has been demonstrated in the frog and in several fishes —**Georges Lakhovsky** The sterilisation of water and of liquids by circuits in metal in direct contact with the liquid

Official Publications Received

BRITISH

Stonyhurst College Observatory Results of Geophysical and Solar Observations 1928 with Report and Notes of the Director Rev E D O'Connor Pp xxii+50 (Blackburn)

Journal of the Chemical Society containing Papers communicated to the Society April Pp. ii+589-852+vii (London)

Imperial Institute Annual Report 1928 by the Director Lieut Gen Sir William Furse to the Board of Governors (Meeting 19th March 1929) Pp vi+36 (London)

Report of the Oversea Settlement Committee for the Year ended 31st December 1928 (Cmd 3308) Pp 48 (London H M Stationery Office.) 9*d* net

Reports of the Progress of Applied Chemistry Issued by the Society of Chemical Industry Vol. 13 1928 Pp 760 (London)

Proceedings of the Royal Society Series A Vol 124 No A 793 May 2 Pp 242 (London Harrison and Sons Ltd) 8*s*

Transactions of the Royal Society of Edinburgh Vol 56 Part 1 No. 11 The Anatomy of a Fœtal African Elephant *Elephas africanus* (Loxodonta africana) Part 3 The Contents of the Thorax and Abdomen and the Skeleton By Dr Nellie B Eales Pp 203-246+6 plates (Edinburgh Robert Grant and Son London Williams and Norgate Ltd) 7*s* 6*d*

FOREIGN

Japanese Journal of Botany Transactions and Abstracts Vol 4 No 3 Pp iv+219-316+55-79 (Tokyo National Research Council of Japan)

Department of Commerce Bureau of Standards Research Paper No 55 An Analysis of the Arc and Spark Spectra of Yttrium (Yt I and Yt II). By William F Meggers and Henry Norris Russell Pp 733-769 10 cents Research Paper No. 56 The Precise Measurement of X ray Dosage By Lauriston S Taylor Pp 771-785 10 cents (Washington D C. Government Printing Office.)

Review of Legal Education in the United States and Canada for the Year 1928. By Alfred Z Reed Pp iii+51 (New York City The Carnegie Foundation for the Advancement of Teaching.) Free

Department of Commerce Bureau of Standards United States Government Master Specification No 28c Lamps Electric Incandescent, Large Tungsten Filament. Supersedes F S B No 28b and Bureau of Standards Circular No 13 11th edition. Revision promulgated by the Federal Specifications Board on March 25 1929 Pp ii+12 (Washington, D C Government Printing Office.) 5 cents

CATALOGUE

Eastman Organic Chemicals. List No. 20 May Pp. 90. (Rochester N Y Eastman Kodak Co.)

Diary of Societies

FRIDAY MAY 24

SOCIETY OF MEDICAL OFFICERS OF HEALTH (Fever Hospital Medical Service Group) at 5 —Dr W M MacFarlane and others Discussion on The Uses of Scarlet Fever Antitoxin

LINNEAN SOCIETY OF LONDON (Anniversary Meeting) at 5 —Presidential Address and Presentation of Linnean Gold Medal to Prof H de Vries

PHYSICAL SOCIETY (at Imperial College of Science) at 5 —Dr Ezer Griffiths A Hygrometer for Use in Timber Seasoning Kilns —Dr J H Vincent Experiments on Magnetostrictive Oscillators at Radio Frequencies —Demonstration of an Apparatus for Measuring the Thermal Expansion of Glass by Prof W E S Turner —Demonstration of the Flutter Model Aeroplane Wings by R A Fraser and W Duncan

ROYAL SOCIETY OF MEDICINE (Disease in Children Section) (Annual General Meeting) at 5 —Dr F J Poynton Some Phases in English Pediatrics as viewed by a General Physician

ROYAL SOCIETY OF MEDICINE (Epidemiology Section) (Annual General Meeting) at 8 —Dr A Joe Puerperal Fever II

ROYAL INSTITUTION OF GREAT BRITAIN at 9 —F J Rennell Rodd The Tuareg Tribes of Central Sahara

INSTITUTE OF CHEMISTRY (Edinburgh and East of Scotland and Glasgow Sections) (jointly with Society of Chemical Industry—Edinburgh and East of Scotland and Glasgow Sections) (at Glasgow).—Prof G G Henderson Recent Research in the Terpene Series

INSTITUTION OF WATER ENGINEERS (at Birmingham)

SATURDAY MAY 25

PHYSIOLOGICAL SOCIETY (in Physiology Department University Edinburgh) at 10 A M and at 2 —H E Magee Prof J J R Macleod and D W Anchinachie Diffusion in Surviving Gut of Different Sugars —J McCallum and H E Magee Effects of Diet and of Adrenalectomy on Movements of Surviving Intestine —H E C Wilson A Note on Specific Dynamic Action —C M Burns (a) Influence of Ingestion of Mineral Acids on the Mineral Constituents of Tissues (b) Influence of Parathormone on the Composition of Bone —D Burns Action of Salts of Guanidine on the Vasomotor System —H Dryerre (a) Effect of Administration of Calcium Chloride on the pH of Urine (b) Calcium Metabolism in Relation to Lactation —May Cameron Differences of Structure between the White and Red Muscles of the Rabbit.—B P Wiesner On the Mechanism of Controlling Changes in Ovarian Endocrine Functions —A W Greenwood On the Effects of Implantation of Cock s Testis into the Hen —E M Robertson On the Zondek Ascheim Pregnancy Test —I Miskaja The Effects of Implantation of Mouse Placenta on the Reproducing System of the Immature Female —W P Kennedy The Ganglion *cervicis uteri* and the Œstrus Hormone —G H Ettinger An Investigation into the Conditions of the Pulmonary Circulation of the Guinea pig —A Fraser and Prof J J R Macleod Glycogen and Lactic Acid in Mammalian Muscle after Death. —G P McCullagh G D F McFadden and Prof T H Milroy Cutaneous Temperatures after Lumbar Sympathectomy —Demonstrations —A C White and C P Stewart On the Estimation of Small Amounts of Soap.—A C White and A J Clark Apparatus for the Estimation of the Oxygen Consumption of the Frog s Heart —Y Bogue Electro-cardiograms from the Hen s Egg —Prof P T Herring Secretion by the Cells of the Convoluted Tubules of the Kidney of the Skate —J D S Cameron Secretion of Urea by the Cells of the Convoluted Tubules of the Kidney of the Dogfish —Sir E Sharpey Schafer The Relation Between the Liver Cells and the Blood —Prof F A E Crew The Miniature Egg of the Domestic Fowl —G H Ettinger (a) Pitfalls Liable to be met with in Perfusion Experiments (b) Peculiarities in Structure of the Pulmonary Arterioles of the Guinea-Pig Ox and Cat.—W O Kermack and W Leiper A New Method for Demonstrating and Measuring the Activity of Pepsin —W W Taylor Method of Determining Free and Bound Water —A R Smellie An Improved Type of Pump for Artificial Respiration —J Davidson Selective Action of Senecifoline on the Liver Cell

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Associates and Students Section) (Annual General Meeting) (Newcastle upon Tyne) at 3.—H S. Jackson Mine Costs.

INSTITUTE OF CHEMISTRY (Edinburgh and East of Scotland Section) (jointly with Society of Chemical Industry—Edinburgh and East of Scotland and Glasgow Sections) (at Glasgow).

MONDAY MAY 27

VICTORIA INSTITUTE (at Central Buildings Westminster) at 4 30 —Sir W M Flinders Petrie The Materialisation of Old Testament History

SURVEYORS INSTITUTION (Annual General Meeting), at 5.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8 —H P Adams English Hospital Planning

ROYAL SOCIETY OF MEDICINE (Odontology Section) (Annual General Meeting) (at Royal College of Surgeons), at 8

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—L J Robbins A Journey in Central Siam

TUESDAY, MAY 28

ROYAL DUBLIN SOCIETY (at Ball s Bridge Dublin), at 4.15.—Prof J Joly A New Form of Needle for Radium Therapy —Dr W R G Atkins and Dr H. H Poole Photo-electric Measurements of Illumination in Relation to Plant Distribution Part II

ROYAL SOCIETY OF MEDICINE (Medicine Section), at 5 —Annual General Meeting.

ROYAL SOCIETY OF MEDICINE, at 5.30 —General Meeting

ZOOLOGICAL SOCIETY OF LONDON, at 5 30.—Secretary Report on the Additions to the Society s Menagerie during the month of April 1929 —W N Blair Observations on the British Shrew *Crocidura cassiteridum*. —Miss E. M Brown Notes on the Larval Stages of the Tompot Blenny *Blennius gattorugine* —Dr C Christy On the African Buffaloes —G C Robson On the Rare Abyssal Octopod *Melanoteuthis* a Contribution to the Phylogeny of the Octopoda

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Kinematograph Group) at 7 —Capt G I Finch A Crossing of Mont Blanc

ROYAL ANTHROPOLOGICAL INSTITUTE at 8 30 —Mrs M Hasluck Turkish Games

WEST KENT SCIENTIFIC SOCIETY (at Wesleyan Hall Blackheath) at 8 30

WEDNESDAY MAY 29

GEOLOGICAL SOCIETY OF LONDON at 5 30.—Dr K S Sandford The Pliocene and Pleistocene Deposits of Wadi Qena and of the Nile Valley between Luxor and Assiut (Qau) —Miss E W Gardner Geological Researches in the Fayûm (Egypt), being a report on work done with the assistance of the Gloyne Outdoor Geological Research Fund

EUGENICS SOCIETY (at Royal Society) at 8 30 —E B Ford Recent Work on the Physiology of Genetics and its Bearing on Human Problems

THURSDAY MAY 30

ROYAL SOCIETY at 4 30 —Prof O W Richardson and P M Davidson The Energy Functions of the H_2 Molecules —Dr E K Rideal C P Snow F I G Rawlins and A M Taylor Infra Red Investigations of Molecular Structure. Part I —C P Snow F I G Rawlins and Dr E K Rideal Infra Red Investigations of Molecular Structure Part II —Dr A Müller The Connexion between the Zig Zag Structure of the Hydrocarbon Chain and the Alternations in the Properties of Odd and Even Numbered Chain Compounds —*Papers to be read in title only* Prof O W Richardson and F S Robertson The Emission of Soft X Rays by Different Elements at Higher Voltages —G I Finch and D L Hodge Gaseous Combustion in Electric Discharge Part III G I Finch and J C Stimson The Electrical Condition of Hot Surfaces during the Adsorption of Gases Part III —J M Robertson An X Ray Investigation of the Structure of Naphthalene and Anthracene —D L Chapman and W K. Hall A Study of the Catalysis by Silver of the Union of Hydrogen and Oxygen —K Majumdar The Arc Spectrum of Chlorine —A E Gillam and R A Morton The Absorption Spectra of Halogens and Inter Halogen Compounds in Solution in Carbon Tetrachloride —K R Rao The Arc Spectrum of Germanium —R H Fowler and A H Wilson A Detailed Study of the Radioactive Decay of and the Penetration of a Particles into a Simplified One-Dimensional Nucleus —U Nakaya On the Emission of Soft X Rays by Different Elements with Reference to the Effect of Adsorbed Gas —R A Frazer and A J Duncan (a) On the Criteria for the Stability of Small Motions (b) On the Numerical Solution of Equations with Complex Roots —N F Mott The Scattering of Fast Electrons by Atomic Nuclei —J J Freeman Further Investigations of the Spectrum of Ionised Nitrogen (N II).—G C McVitie On Einstein s Unified Field Theory —I P Davies The Soft X Ray Emission from Various Elements after Oxidation

INSTITUTE OF PATHOLOGY AND RESEARCH (St Mary s Hospital) at 5 —Prof F W Twort The Position of Ultramicroscopic Viruses in the Living World

CHEMICAL SOCIETY (at Institution of Mechanical Engineers) at 5 30 —Prof W H Perkin The Early History of the Synthesis of Closed Carbon Chains (Pedler Lecture).

ROYAL SOCIETY OF MEDICINE (Electro Therapeutics Section) (at Langham Hotel) at 7 —Annual General Meeting

C B C SOCIETY FOR CONSTRUCTIVE BIRTH CONTROL AND RACIAL PROGRESS (at Essex Hall Strand) at 8 —Dr M Thomson Sterilisation of the Unfit.

FRIDAY MAY 31

ROYAL INSTITUTION OF GREAT BRITAIN at 9 —Prof E N da C Andrade The Air Pump Past and Present

PUBLIC LECTURES

FRIDAY MAY 24

BIRKBECK COLLEGE at 5 30 —Prof S de Geer Sweden and the North of Europe (Succeeding Lectures on May 28 and 30.)

MONDAY MAY 27

ROYAL SCHOOL OF MINES at 5 15 —Dr C J Smithells Minor Constituents in Industrial Metals and Alloys (Armourers and Brasiers Company Lectures—continued on June 3 and 10)

SIR JOHN CASS TECHNICAL INSTITUTE, at 7 —Dr M A. Matthews Low Temperature Tar

TUESDAY MAY 28

UNIVERSITY COLLEGE at 5 30 —Prof A Brachet Experimental Embryology (Succeeding Lectures on May 29 and 31)

WEDNESDAY, MAY 29

UNIVERSITY COLLEGE at 5 30 —Prof E D Wiersma The Psychology of Dementia. (Succeeding Lecture on May 30)

NORTHAMPTON POLYTECHNIC INSTITUTE, at 7 —G Patchin Engineering Alloys (Armourers and Brasiers Company Lectures—continued on June 5 and 12).

THURSDAY, MAY 30.

LONDON SCHOOL OF ECONOMICS, at 5.—Prof A. Aall The Psychology of the Individual and of the Mass (Succeeding Lecture on May 31)

FRIDAY, MAY 31

CHELSEA PHYSIC GARDEN, at 5 —H V Taylor Supplies from the Vegetable Kingdom and the Public Health (Chadwick Lecture).

SATURDAY, JUNE 1 1929

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University Staffs and Salaries

WHAT reforms in the present organisation of the universities of Great Britain other than *Oxford and Cambridge may be deemed necessary* for the continuance of their professed functions ? So long ago as September 1924 in the course of an article on university staffs and university finance we suggested that drastic changes were inevitable and probably imminent however unprepared for them the universities might be The publication of the Returns of the University Grants Committee for last year [1] encourages us to resume this urgent topic The Commissioners survey does not suggest that there has been any material change in the general financial position of the University Institutions concerned By a process of logic which must be somewhat unconventional the Commissioners infer from this statement that Steady if unsensational progress continues to be made Nothing stands still no disaster has attended the affairs of the universities so they must be progressing

The Commissioners have of course a very delicate and difficult task before them They represent a degree of official enlightenment rare in affairs of State The old order is still very much the old order in the universities The State s contribution last year represented very little short of three quarters of the salaries paid The policy of the Grants Committee is well known It is to make an end if possible of the prevailing gross under payment of staffs The salary bill is by far the largest presented to the universities—more than half the total expenditure which for the first time exceeds £5 000 000 The Grants Committee allocates £1 523 772 The total parliamentary grants reach £1 841 005 The first of these figures represents actually an excess over the million and a half promised The commitment was formerly only a million and in agreeing to increase it the Committee expressed the opinion that the greater part of the extra amount should be devoted to raising salaries This has not been done Some of the universities claim that it has been done but the figures contradict them The sum of £90 000 under the heading Salaries and Superannuation by which university expenditure for last year exceeded that in the previous year covers both increased salaries and the cost of new posts Since new posts number eighty four the sum devoted to correcting total inadequacy of remuneration could not have

[1] University Grants Committee Returns from Universities and University Colleges in receipt of Treasury Grant, 1927 28. Pp 24 (London H M Stationery Office, 1929) 3s net.

been enough for the needs of a single one of the larger institutions

We are where we were, and the optimism which leads the Commissioners to interpret some movements as necessarily progressive appears scarcely to be justified Had there been any real deference to the wishes of the Committee, it is evident that it would be revealed in an alteration in the proportion which salaries bear to total expenditure An approximation which takes us back to 1922–23 can be gained from the whole maintenance table in the Return which excludes Oxford and Cambridge 65 3 per cent in 1922–23, 65 3 per cent in 1926–27 and 65 9 per cent last year Another table provides the actual figures for the past two years for salaries and superannuation alone 50 03 per cent in 1926–27 and 50 4 per cent last year

From under payment of university staffs a whole train of evils proceeds While a sufficient number of eminent representatives of an earlier social and intellectual environment remain to give an appearance of dignity to academic pursuits there is and can be no assurance for the future so long as the standard of remuneration is one far exceeded by the earnings of many shop assistants, let alone professional men and those engaged in the vague if profitable service of the community 'business' so long as every interest', professional commercial or industrial, can attract the livelier and more competent from concern with fundamentals to concern with applications so long as modern educational demands however legitimate are permitted to prevent the performance of the avowed intentions of founders and patrons

In every human activity much depends upon the actual human beings engaged in its maintenance but it is doubtful whether this dependence upon the quality and devotion and performance of individuals is so absolute anywhere else as in the universities Their fellow citizens, even those of them who have personal acquaintance with a university, still retain a sort of inertia of reverence for it and for its sister institutions, as the fount and origin of knowledge The creative spirit in the arts and humane letters may and does rise to greater altitudes elsewhere, the same spirit in discovery, the fundamental natural law giving, whence all other discovery and invention proceed, can in modern conditions thrive nowhere else Here alone is the living knowledge, undiminished by secondary understanding and uncontaminated by the ageing falsity of books Shelley's question "as to how far a thirst for a happier condition of moral and political society survives among the enlightened and refined the tempests which have shaken the age in which we live' is answered in our own time, if the recompense of these excellencies is only penury and social excommunication

To advance knowledge and to extend science strictly interpreted—interpreted, that is to say as W K Clifford interpreted scientific *thought* as distinct from the slightly humbler use of other people s scientific thoughts—is a work for genius Those who possess it are a minority of academic workers, as they are a minority in the community as a whole They will always be attracted to university work irrespective of the conditions But that does not absolve the community from its responsibility If the flame of intellectual conquest burns so consumingly in such men that they will sacrifice every human and humane obligation for its satisfaction, the social conscience is surely guilty if while it is aware of the sublime benefits which are bestowed, it neglects to intervene for the protection of needy dependents If it seems then an act of folly or of genius to accept the present terms of most of the universities in Britain must we conclude that the majority who do accept these terms cannot be of the stuff which gives body to the intellectual resources of the country? The time must come when that will be true Those who possess what is after all a marketable talent can be retained in the service of the universities only at a just price

The earnest local patriotism and idealism which brought the newer universities into being did not in the first place correctly envisage the human and financial obligations involved, and are now inadequate to rectify the evils which have ensued State aid is directed particularly to reform, but reform is refused Why? The scarcity of relevant facts upon which an answer to this question might be based is one of the reasons which render the appointment of a commission with full powers so urgently necessary There is no common recognition of the claims of disinterested inquiry The politician in all his forms, parochial to imperial, promises wider and wider educational advantages, scholarships increase, but the real philanthropist is the academic worker The rich donor supplies only the bricks and mortar, it is the teacher and research worker who supply the human material at their own cost For true education or for self-advancement the community must be supplied with a superabundance of facilities, and the academic worker must pay the cost Organisation would of course soon bring the administrative mind to its senses, but organisation is prevented by cross-currents of sectional interest, by fear, by pride, and

not least by ignorance One faculty does not know what another does In consequence the presentation of the just claims of one against another is sometimes embittered and the sources of defeat may be disguised and concealed

Some incredulity may be occasioned by the statement that the universities have recently made an official representation for the purpose not of bettering the condition of staffs but of securing the withdrawal of existing forces which might be expected to achieve that end Resistance to trade union action is intelligible and these facts are not put forward without some sympathy with that view Nevertheless they indicate the danger underlying sectional and particularly professional representation of the university opinion One of the newer universities recently defended itself against a public charge by stating that the universities were powerless in the matter having merely to obey the General Medical Council Sixty six per cent of the Council are elected by the universities and colleges Powerlessness is therefore not apparent Too often faculties act for universities and in medicine the faculties are virtually the practising profession

At some time between the summer of 1926 and the end of 1927 the governing bodies of the universities asked for the withdrawal of a modest scale of remuneration for non professorial university workers which the British Medical Association had proposed to enforce In consequence a conference was held on Feb 10 1928 between representatives of the Association and representatives of the medical schools mostly deans These representatives created the impression that non professorial medical workers had many privileges and were at all events merely using the universities as stepping stones to lucrative practice A *non possumus* resolution was passed Last summer not this resolution but another exempting temporary workers and temporary workers only from the operation of the scale was passed by the Representative Body of the Association An amendment by the Hendon division which insisted that in no case could anatomists and physiologists be regarded as temporary workers was accepted rather dubiously by the chairman making this meaning clearer Very few weeks had passed however before the *British Medical Journal* contained advertisements for anatomists and physiologists at salaries £200 below the scale Inquiry elicited the information that the appointments were temporary although one man (at Sheffield) was to be equipped in every imaginable non clinical direction and able to take the place of the professor in his absence The medical profession fears—quite unnecessarily—that the present wasteful and absurd system of artificially favoured seniority will be jeopardised if young and brilliant men are made independent of patronage Other faculties fear preferential treatment which admittedly would be disastrous to the university idea But the example given is but one of the pernicious results of professional patronage and is worthy of the consideration of members of all faculties

Naturally the Returns refer to the comparative neglect of the Biological Sciences other than Medicine May we suggest that one of the matters considered by the Joint Committee which has been appointed to examine the practical steps which should be taken to secure the development of the teaching of Biology by co operation between the Universities and the secondary schools would very appropriately be the desirability of remunerating the teachers at least as well as the taught ? At one university where a scale has been sanctioned and re sanctioned it is impossible under the scale for any non professorial teacher to attain to a salary of £500 a year in less than thirteen years In some cases the men concerned could not be employed elsewhere at a salary below £600 for the first of these thirteen years

Sufficient has been said to show that inquiry and inquiry alone can now disentangle the multitude of interests involved Four years ago we said

It is absurd to pretend that under such conditions their normal duties can be efficiently conducted and an inquiry into the whole question of payment and the evils that are arising from continued under payment is undoubtedly urgent before the rot has time to inflict permanent harm on university teaching The rot advances Time which should properly be spent in research or recreation is used to supplement meagre and insufficient incomes Financial pressure and the vastly wider facilities for research under Government supervision drain from university service many men of superior ability The universities afford fewer and fewer opportunities of instruction at first hand by men actually engaged in the advancement of their subjects and the loss to students denied personal contact with original and creative minds will speedily destroy the whole significance of university training Already there are fundamental departments of science which have been neglected in England for a quarter of a century

No material change does not mean steady progress It means that decline is inevitable unless there is a substantial improvement of existing conditions

Ancient Knossos

The Palace of Minos a Comparative Account of the Successive Stages of the Early Cretan Civilisation as illustrated by the Discoveries at Knossos By Sir Arthur Evans Vol 2, Part 1 *Fresh Lights on Origins and External Relations, the Restoration in Town and Palace after Seismic Catastrophe towards close of M M III, and the Beginnings of the New Era* Pp xxii + 390 + 10 plates Vol 2, Part 2 *Town-houses in Knossos of the New Era and restored West Palace Section, with its State Approach* Pp xiv + 391 844 + 18 plates (London Macmillan and Co, Ltd, 1928) 147s net

IT is now nearly thirty years since the political liberation of Crete from Turkish rule made excavation possible on the site of ancient Knossos, and the knoll then called Kephála had been recognised, some ten years earlier still, as concealing a pre Hellenic building, one or two chambers of which—part of the famous 'palace magazines'—were indeed partially opened by a Cretan gentleman who had been appropriately christened Minos Almost without intermission since 1900—except in the War years—and under the single direction of Sir Arthur Evans, the dissection, and latterly also the reconstruction, of a 'Palace of Minos' has gone on, with ever widening scope outside the palace area, and ever growing wealth of experience suggesting re-examination of structures and substructures already recognised and cleared

In the first years of tentative discovery, a bulletin of each season's proceedings, in the *Annual* of the British School of Archæology at Athens, was publication enough Later came monographs, in *Archæologia* and elsewhere, on special enterprises, such as the opening of the 'Royal Tombs' hard by, and the first volume of "Scripta Minoa" on the earlier and mainly pictographic phases of the Minoan script The later 'linear' scripts still remain for the most part unpublished, though most of the documents were found quite in the earliest seasons' work Then in 1921 appeared the first volume of "The Palace of Minos at Knossos", bringing together in masterly perspective the main results so far as they concern the history of the site, and the chief phases of its civilisation down to the point at which it begins to be proper to speak of a 'palace' there at all Next came another interval punctuated with published studies of special problems, the paper on the "Ring of Nestor" and other remarkable pieces of engraved gold work from the Greek mainland, and the Huxley Lecture on early connexions between Crete, Libya, and the Nile Valley, and now we have the second volume of "The Palace of Minos at Knossos", ampler even than the first, but happily bound up in two sections, which make it a much less formidable implement of study and reference

This new volume does not merely take up the story where it was left by its predecessor As the author frankly says, "the excavation of Knossos itself may almost be said to have renewed its youth", it has been "a perpetual source of wonderment" to the excavator, supplementing, and almost invariably substantiating earlier observations and conjectures So multiple and diverse are these discoveries, that merely to marshal them in intelligible order is a notable achievement Habitual users will note with satisfaction that the pagination of the two parts of volume 2 is continuous, and also that the numbering of the sections is continuous with that of volume 1, a very great aid to concise reference

The sections contained in the two parts of volume 2 run from § 33 to § 67 inclusive, and deal mainly, though not by any means exclusively, with the latter part of the Middle Minoan and the beginning of the Late Minoan phases, that is to say, from about 1750 to 1500 B C Each deals at the same time with a separate topic or problem, and advances the general argument and historical reconstruction But since the appearance of volume 1 in 1921 a good deal has been done to clear up obscurities and supplement what was known then about the earlier periods, and §§ 33 34 serve also as a retrospect both of these years of work of the early Minoan and adolescent Middle Minoan phases, and of the general position of Crete and its culture in the ancient world

Beneath the central court of the later palaces, the discovery of late neolithic houses gives occasion (§ 33) to a revised estimate of the connexion between the earliest occupants of this part of Crete and the people of Asia Minor, which is represented as more directly concerned than the Greek peninsula, though it is still over-early to decide this point Western Crete has scarcely been touched yet, and very little has been done in mainland districts south of Argolis Moreover, even in Asia Minor the rugged south-western districts are still almost unknown, and comparisons between Crete and Cappadocia are necessarily provisional Geographically, however, access has always been comparatively easy from southern Asia Minor to Crete, thanks to the set of the current and the

regularity of the *imbat* winds, far more important for coastal traffic than the seasonal *meltem*

For this reason it may well be that eventual intercourse with the Nile Valley (§ 34) was for Crete rather an extension of this coastal traffic than the result of transmarine exploration Probably what gave this intercourse its vogue and vitalising force at both ends was the discovery that at the far extremity of the " Great Bight "—to modernise an Egyptian phrase about the ' great circuit of the lands "—it was possible to spread sail before a *meltem*, as the fruit boats of Cos do now, and regain the Nile mouths in a few days It is important, however, to distinguish (as is here done) Nilotic from other Libyan intercourse , and in early days it is the latter that appears to have been primary, as a number of distinct elements show , types of boats, hair dressing, costume, stone worked vessels, cupola tombs, and so forth In early dynastic times, when the Delta became Egyptised, Egyptian influence succeeds to Libyan in this Cretan ' staple ' or depot

How did this oversea traffic come ? By a ' transit road ' traced (§ 35) from minute ports nestling under the Asterusian ridge south of the Messarà plain, over the well guarded pass east of Mount Ida, and round the west shoulder of Mount Juktas, entering Knossos eventually by the Minoan viaduct (§ 36) with its caravanserai, bath house, and ' partridge fresco ' (§ 37), and the ' stepped portico ' (§ 38) rising into the south end of the ' palace ' site Special problems of technique and procedure confronted the excavator here, for the sintered soil was as hard as the masonry of the viaduct, and the spirits of the workmen had to be maintained by a fresh plan of remuneration The technique of Minoan commerce, too, demands special examination of the means of transport, ox, ass, eventually horse and mule , wheeled vehicles for goods, courier borne palanquins for notables, as a fragmentary fresco shows

What went by this age long road, and whither ? The answer (§ 39) comes from the signs of Minoan influence far away to the west and north, in Malta, the Iberian peninsula, even in Britain The connexion between early Maltese monuments and Minoan arts and practices has been disputed, more than once, and there is still a question of degree , but it becomes difficult to dissociate the decorative motives, and if these be borrowed from Minoan, the relative date of the Maltese culture seems to be determined, and therewith much in the western Mediterranean In the other direction, Cretan arts of design, already known to have affected Egyptian decorative work in the Eighteenth Dynasty, are now (§§ 40, 41) detected in a similar relation to the Middle Empire , a conspicuous instance is the recent find at Harageh, dated to the time of Sneferu II , about 1890 B C

Corresponding with the ports of the south coast, the harbour town of Knossos itself has been discovered and partially explored (§ 42) , but lying in the outskirts of modern Candia, and moreover in the zone devastated by both Venetians and Turks during the great seventeenth century siege, it contributes only suggestive details In addition to her other functions, the ' Great Goddess ' looked after seafarers, anticipating both Isis Pelagia in classical times, and the medieval Madonna Is it, however, certain that all these representations of potent or protective women are attributable to one and the same goddess, or rather (as Nilsson suggests in his " Minoan Mycenæan Religion ") to several, perhaps many, departmental deities ? Through this—and probably also through other ports on the north coast, Nirou Khani, for example (§ 44)—Crete was apparently brought into separate intercourse with Syrian centres, and their cults and manners (§ 43) illustrated by a fashion of bull headed libation vessels, and by occasional finds of cylinder seals Deeper seated are those aspects of Cretan religious belief which are illustrated by the insignia of a priest king from the French excavations at Mallia, and by the curious find at Nirou-Khani, which Sir Arthur Evans describes as a " propagandist depot ", of portable altars and double axes

After these retrospective and supplementary studies, resulting from the last few years' operations, the main thread of the story is taken up again in § 45 at the moment of the disastrous earthquake which wrecked Knossos during the Third Middle-Minoan period, and profoundly affected its subsequent fortunes The direct damage was serious enough, especially in the south-east quarter of the ' palace ', where the site had been greatly enlarged over substructures which now collapsed and overwhelmed the houses which occupied the slopes below But the moral effects were more lasting (§ 46) Propitiatory ritual before rebuildings was natural enough, and is illustrated graphically , but the new custom seems to have come to stay, in the form of a ' pillar-cult ', and the worship of an ' earth-shaker ' incarnate in bull-form, side by side with the god of the ' double axe ' (§ 47) and at times merged in him The general ' distress of nations ' after the disaster is shown directly by the marked reduction of the occupied area at

Knossos, and no less vividly by those emigrations of which the settlements on the Greek mainland about this time are the first fruits In quite a different direction, widespread ruin meant abundant opportunity for the builder and decorator (§§ 48 54) As we have seen in our own time, at such a period of 'reparations' the arts progress rapidly (§ 48), experiments are tried on every hand, foreign models have their vogue, and the copies of the first imitators pass into the common repertory of their successors Was it such a change of taste, or another earthquake (such as Crete seems to suffer about twice in a century) that brought about the 'scrapping' of the lovely painted stucco in the 'House of the Frescoes'—the "cultured home of a small burgher"—outside the Palace proper (§ 52)? And why were the 'scrapped' fragments so carefully stowed away in the house itself, to the delight of posterity? It is a further discovery (§ 53), that the decoration of house walls and other large scale work is the source and inspiration of the minuscule art and abridged designs of the pottery and perishable gear of everyday life

In these artistically favourable circumstances arose from the ruins of the 'older palace' the 'broad Knossos' of Homeric folk memory, in the golden age of Minoan Crete (§ 56) Fearless, because secure abroad, and therefore unfortified and unconfined, the growing population spent growing wealth on commodious suburbs, beyond the Kairatos river, for example (§ 55), and other Cretan towns flourished accordingly An eloquent signal is the rapid disuse of timber for house building, as in our own Renaissance, deforestation had begun

The remainder of the volume (§§ 57 67) surveys the reconstructed 'palace' in systematic order, beginning with the 'state approach' from the north-west (§ 57), the 'theatral area' for receptions and pageantry, the 'west court', and the 'treasure house' (§ 59), with its splendid hoard of bronze vessels and household furniture (§ 60), and the 'west porch' (§ 61) and 'south propylæum' (§ 62) with their processional frescoes, to which the well known 'cup bearer' belongs Here is the occasion for discussing the no less famous 'Keftiu tributaries' from the walls of Egyptian tombs, and the tell tale offerings which they carry (§ 63) So we pass on into the 'ceremonial corridor' (§§ 64 65), which runs north and south into the main mass of 'palace' structures, and so to the 'central court' (§ 66), where it has even been possible to recover the main architectural features of the façade, and to detect links between the religious ritual of the 'sanctuary quarter' of the 'palace' and the worship of Apollo at Delphi, a striking counterpart to the Greek legend of the Cretan origin of the Delphic priesthood, and to the worship of the 'Delphinian' Apollo at Knossos, and elsewhere in Crete, in Hellenic times

For the remainder of the Late Minoan buildings, and especially for the magnificent 'north gate' and its decorations, we have still to wait for volume 3, and still more have we to wait for an index, but it is only right to acknowledge the utility, meanwhile, of the marginal catch titles, and the analysis prefixed to each section and to admire the skill with which so vast and at first sight heterogeneous a collection of data has been arranged so that each topic occurs, like an episode of saga, in a context which is memorable in itself, and makes subsequent reference easy

That is in itself a feat of no mean art, as everyone will admit who has had to write reports of excavation So much that is found is always at first sight negligible or inexplicable, but for this very reason must be all the more scrupulously recorded and conserved So much, at the same time, that seems essential to any reconstruction at all, is *not* found, but has to be 'restored' with more or less confidence—and 'scrapped' sometimes, like any other hypothesis, as knowledge grows In Ægean archæology, knowledge has grown amazingly, though very unevenly, while Knossos itself has been under examination, even in Crete, American, French, Italian, Greek, and other British excavators have contributed much, especially to fill certain gaps in the Knossian series, for example, about the time of the great earthquake, and also in respect of those early periods, the deposits from which were levelled away from the top of the Kephála hill when 'palace' construction began With these exceptions, Knossos has remained, as it began, central and typical, and the record of its recovery is a classic of archæological literature

Scarcely less unusual than his presentation of results has been the excavator's treatment of the 'palace' as an exhibit and a place of study Nothing is more dreary or confusing than the litter of displaced fragments which disfigures most sites after excavation, except perhaps the knowledge that this or that important detail is 'now in London' or elsewhere Now, at Knossos, nothing has been removed, except to the Candia Museum for safe custody, nothing, on the other hand, of which the place could be ascertained, has been

allowed to remain out of that place, if the understanding of the whole could be facilitated thereby This has meant unusual expenditure and labour in reconstruction, the provision of facsimiles of fallen frescoes and other perishable detail, the unpicking and rebuilding of crushed or unstable walls Examples are apparent in the illustrations to this volume, and some of them are startling in their audacity, when they are judged by other people's practice But no one, it must be remembered, has ever had a site of this quality to study or to dissect under such favourable conditions, with complete continuity of direction, and concentration of responsibility and initiative Remote as Knossos is, and must remain, it is a place of pilgrimage for students of archæology—the art and technique of recovering the past—as well of antiquity, and it is only when the attempt is made to reconstruct the Kephála of thirty years ago from the recreated Knossos of to day that the full meaning of this record is appreciated

J L M

Incidental Natural History

(1) *Further Correspondence of John Ray* Edited by Dr Robert W T Gunther (The Ray Society Volume for the Year 1928, No 114) Pp xxiv + 332 + 4 plates (London Dulau and Co, Ltd, 1928) 12s 6d net

(2) *Physiologus a Metrical Bestiary of Twelve Chapters by Bishop Theobald* Printed in Cologne, 1492 The Author is believed to have been Abbot of Monte Cassino A D 1022–1035, and a Description of the Abbey is appended with Illustrations Translated by Lieut-Col Alan Wood Rendell Pp xxvii + 34 + 100 + 15 plates (London John and Edward Bumpus, Ltd, 1928) 10s 6d net

(1) THE Ray Society has already issued two works, the "Memorials" (1846) and the "Correspondence of John Ray" (1848), which may be said to have achieved their object of keeping alive the memory of "the greatest all-round naturalist of his time" The present addition, made possible by financial assistance from a revered and venerable successor of John Ray, Prof W C. M'Intosh, "is the outcome of a re-discovery in the Bodleian Library of a number of letters of John Ray which have not only never been printed *in extenso*, but which form a necessary supplement to the volume of *The Correspondence*" To these have been added materials obtained from the *Philosophical Transactions* and archives of the Royal Society, and from the British Museum The work has been edited by Dr R W T Gunther, to whose activities the history of science owes many useful contributions Although the short lives of Ray by Dale and Petiver are reprinted, Dr Gunther's volume is not, and does not pretend to be, a final biography of Ray in the form of a coherent narrative, and its interest lies rather in a series of disconnected incidents and opinions which nevertheless will be most valuable to the future biographer of Ray when he appears Ray is generally believed to have been born in 1628 and to have died in 1705 The dates inscribed on his tomb are 1628 and 1706 Both are now stated to be erroneous, the latter being corrected to 1705, and as regards the former, we have the evidence of the parish register that he was born in 1627

To give some idea of the contents of the volume, a few samples may be selected The letter on the anatomy of the 'Porpess", dated 1671, is printed in full, and illustrates fairly Ray's powers and limitations as an anatomist and a systematist It does not compare very favourably with the fuller account of the anatomy of the same animal published in 1680 by Edward Tyson Ray, however, clearly recognises and demonstrates that the anatomy of the porpoise must be interpreted in terms of the quadruped, which after all is the main point Nevertheless, in his "Historia Piscium", published in 1686, he still retains the Cetacea among the fishes He describes also the compound stomach of the porpoise, the lobulate kidneys and the mammal like genitalia Although he mentions the elongated larynx, he failed to recognise, as did all the older comparative anatomists, the existence of, and the reason for, an intranarial epiglottis The brain is briefly and accurately described, but he missed the external auditory meatus, which, though very small, had been seen by Belon and Rondeletius before him, and by Daniel Major and Tyson immediately after

An interesting account is given of the publication of Ray's work on fishes, the expenses of which plunged the Royal Society into a state of bankruptcy Samuel Pepys, at that time president of the Society, took a deep interest in this work, which was dedicated to him In spite of the fact that the cost of a number of the 187 plates had been guaranteed, there was a deficit of £360, and an attempt to dispose of 400 copies abroad at 25s a copy having apparently failed, the Society was unable to pay the stipends of its officers in cash, but offered them instead copies of this unremunerative

work It was sold at the time for 20s, and it may be noted that its present market value is about £3, 10s

Ray was naturally familiar with the horn of the narwhal, but had interpreted it as a median structure, and had not been aware, until informed by Edward Lhwyd, that the horn may be paired He, however, missed the significance of this variation, but regarded the paired condition as normal, "so that we are again to seek for a Monoceros, which we had thought we had found among fishes" It is somewhat surprising to find that Ray knew the work of Leonhard Baldner, the Strasbourg fisherman, who published the first observations on the metamorphosis of the lamprey in 1666 Ray, however, "not understanding high Dutch", was unable to make much use of Baldner's work, whose name, by the way, he mis spells Baltner

Some of the letters show that the mild and uncomplaining Ray could on occasion scarify his contemporaries, and in this respect he appears in a new light Walter Charleton comes in for severe treatment He "did not understand animals", his "Onomasticon Zoicon" was cribbed and inaccurate, and he is surprised that "such a book should find so much acceptance as to come to a second impression" Dr Woodward is arrogant, presumptuous, and highly conceited, his notions are ridiculous, but, adds Ray in mitigation, the interpretation of fossils is so difficult that "a man hazards his reputation that is positive and confident on either side"

We must express our indebtedness to Dr Gunther for this important collection of Raviana, and he has increased the obligation by preparing an index which covers not only his own volume, but also the previous collection of letters published in 1848

(2) This work includes an illustrated description of the famous Benedictine monastery of Monte Cassino, about 90 miles from Rome—a description which has some topical interest, since the Abbey is at the moment celebrating the fourteen hundredth anniversary of its foundation This description will therefore be useful to those who are visiting Rome, and may induce them to include in their tour an excursion to Monte Cassino We have not visited the monastery personally, but we would ask whether there is not something radically wrong with the date ascribed to the arcade figured in Plate 14

Col Rendell has performed a very useful service to learning by publishing a photographic reproduction of this important and fascinating incunable We wish that considerations of expense did not preclude the practice being generally followed Such a reproduction is practically as good for the purposes of study as the original, and we can only regret that the Bishop's inspiration did not run to the whole of the forty or so chapters of the "Physiologus" Col Rendell, however, has done more than reproduce his copy of this rare book—he has provided us with a translation of it, a serious task, of the merit of which there may be differences of opinion, but of which none will question the usefulness The condensed and at times erratic form of the original makes a literal translation, which Col Rendell has attempted, particularly difficult, and he has not always succeeded in the double object of abiding by the text and at the same time producing a version in intelligible English He confines himself largely to the 1492 edition of the Bestiary, and does not concern himself with the extensive literature of the "Physiologus", nor with discussions of such questions as a comparison of "Physiologus" with the "Nuzhatu l Qulûb", recently attempted by Col Stephenson

There are two appendices—one a partial translation of an Italian article on an unpublished moralised Bestiary of the twelfth century from the archives of the Chapter of Fano, and the other a comparison of the Fano version with the Cologne printed text of 1492, and another Latin version known as the Migne

Popular Astronomy

(1) *The Sun, the Stars, and the Universe* By Dr W M Smart Pp xii + 291 + 20 plates (London, New York and Toronto Longmans, Green and Co, Ltd, 1928) 12s 6d net

(2) *Astrophysics the Characteristics and Evolution of the Stars* By Dr W M Smart (Benn's Sixpenny Library, No 36) Pp 80 (London Ernest Benn, Ltd, 1928) 6d

RESEARCH in astronomy in these days is so fascinating and exacting a pursuit that one could understand, if not excuse, the neglect of one of the primary duties of investigators—to inform the general public of the progress of their science It is essential that this should be done by astronomers themselves, for, in the bewildering speed of modern progress, they alone have the least chance of seeing the position steadily and seeing it whole. Fortunately, they have not neglected their duty During the last few years there has been a remark-

able output of popular astronomical literature of a trustworthy type, and there is now no difficulty, as once there was, in directing an inquirer, of whatever intellectual capacity, to a satisfactory account of the astronomical knowledge so far obtained Dr Smart is the latest addition to the band of authoritative expositors, and the two books before us make it clear that he is well fitted for the task which he has undertaken

(1) The larger volume—"The Sun, the Stars, and the Universe"—' has been designed to present, in descriptive language and with an historical background, an account of modern astronomical discoveries and of present day views concerning the characteristics, constitution, and organisation of the heavenly bodies" This is a fair statement of its achievements, and indicates better than the title what aspects of general astronomy have been selected for consideration The order of treatment is not unconventional The first four chapters are introductory in character, dealing in general terms with the solar system, the celestial sphere, some aspects of early astronomical history, and astronomical instruments—the chapter describing the last named being inadequately entitled "The Telescope" Then follow two chapters on the sun, and one on the moon, planets, and comets, after which the various departments of stellar astronomy are discussed in eight chapters Three of these are devoted to the movements of the stars—an unusually large proportion, for which, however, there is much to be said It scarcely exaggerates the importance which stellar movements are likely to assume in the future progress of astronomy Two further chapters—on star clusters and nebulæ, and the universe, respectively—bring the book to a conclusion The illustrations are numerous and well chosen, and are excellently reproduced

The treatment throughout is as non technical as possible, and entirely non mathematical it does not, however, on that account suffer in accuracy or precision In one respect, perhaps, the ideal of precision has been followed too unswervingly Dr Smart states in the preface that when the chapter on stellar evolution was written there were three different evolutionary theories in the field, and it seemed advisable "in a popular book to devote the available space to a somewhat detailed account of one theory rather than to attempt to produce a condensed description of all three" It is at least questionable if the existence of a multiplicity of expert opinions on any matter is a valid reason for describing only one in a non polemical work—and particularly for giving "a somewhat detailed account" of that one It is doubtful, too, if the nebulous state of general opinion on stellar evolution can be said to contain anything so definite as "three theories" An appropriate vagueness in the tone (not the logical meaning) of the account of this subject, condensing here and there into the chief features of the various bodies of thought, would possibly have given a truer account of the actual state of affairs than a clear cut description of a particular view It is only fair, however, to add that Dr Smart makes no attempt to hide or disguise the difficulties and uncertainties of the subject

(2) The little volume on 'Astrophysics", which is a member of Messrs Benn's admirable Sixpenny Library, necessarily deals with much the same material as the later portion of the larger work It is carefully planned and is very successful in covering a great deal of ground without giving the impression of undue haste It is illustrated by several diagrams and is altogether appropriate to the character of the series of books to which it belongs

Dr Smart writes clearly and interestingly His sentences are rarely, if ever, ambiguous, and his accuracy is as great as can be expected of one man who undertakes to survey so vast a field The inevitable slips and misprints are few and unimportant He has, however, an unfortunate tendency of aiming at stimulating the imagination by the use of hyperbole This is sometimes merely ineffective, as in the frequent repetition of such words as stupendous' and amazing', and sometimes definitely misleading, as in the remark that the radial velocities of spiral nebulæ are 'incomparably' greater than the velocities of galactic objects (Incidentally, it may be questioned whether it is not the smallness rather than the greatness of the velocities of spirals that is most striking With a possibility of relative velocities up to the speed of light, is it not surprising and probably significant that independent universes should amble past one another at no more than about 1000 miles per second ?) This characteristic is expressive of the failure—far too general among writers of popular scientific books—to distinguish between the educated, non scientific man and the child Dr Smart is too able an expositor to be allowed to persist in this attitude without protest, and we trust that in his future writings he will give the same careful attention to the mental characteristics of his prospective readers as he does to the subject on which he writes

H D

Our Bookshelf

The Application of Science to the Steel Industry By Dr W H Hatfield (Edward De Mille Campbell Memorial Lecture, presented in Philadelphia, October 10, 1928, at the Tenth Annual Convention of the American Society for Steel Treating) Pp vii + 154 (Cleveland, Ohio American Society for Steel Treating, 1928)

THIS volume contains the substance of a series of lectures delivered by the author in the course of a visit to the United States during last autumn, and deals with modern developments in the manufacture and use of steel As chairman of the Steel Ingots Committee, Dr Hatfield naturally gives prominence to the work of that committee, and lays stress on the importance of ingot structure for the quality of the finished steel This section forms a useful introduction to the subject, and is well illustrated The principles of heat treatment are next considered, again with the presentation of abundant material from technical practice

The metallurgist will naturally turn with great interest to the remaining four sections, dealing respectively with special engineering steels, corrosion resisting and stainless steels, steels intended for use at high temperatures, and with tool and cutlery steels On all these matters the author is in an exceptional position for the collection of full and accurate data, and his numerous tables form a most valuable compendium of information on such subjects In deference to the audiences before which the lectures were delivered, temperatures are given on the Fahrenheit scale, but the Centigrade values are added in brackets The author would render a service to metallurgy if he could persuade American workers to come into line with the rest of the world in this respect

Dr Hatfield has been very frank in including information which is often, for commercial reasons, difficult to obtain, and the volume, although small, will be frequently consulted, especially for the more complex alloy steels intended to resist creep at high temperatures, and other recent features of the industry The references to the literature are abundant, but marred by numerous minor inaccuracies The author is to be congratulated on a very useful piece of work

Praktische Einführung in die Morphologie der Insekten ein Hilfsbuch für Lehrer, Studierende, und Entomophile Von Prof Dr Eduard Handschin (Sammlung naturwissenschaftlicher Praktika, Band 16) Pp viii + 112 (Berlin Gebrüder Borntraeger, 1928) 11 gold marks

THIS handbook is designed to meet the need for a practical manual for the laboratory training of entomology students in the elements of insect morphology Its plan of arrangement is that each chapter is devoted to a separate region of the insect body, and is preceded by a short list of papers useful to the student for further reading The author, it may be added, has borne in mind the importance of explaining structure in terms of function By means of a series of judiciously selected types the student is led to understand the significance of the chief structural modifications found among representative insects A considerable number of common and usually easily procurable species are used as types for dissection, and having mastered the course laid down, the beginner should have acquired a sound general acquaintance with the external structure of these animals As a supplementary guide to practical work, a separate atlas of 23 plates is provided at the end of the book Its figures illustrate practically all features discussed in the text, they are models of clarity and are for the most part original The book can be recommended as a concise and thoroughly accurate laboratory manual

A D IMMS

The Industrial Uses of Bauxite with an Account of its Origin, Occurrence, Composition, and Properties By Dr N V S Knibbs Pp 141 (London Ernest Benn, Ltd, 1928) 21s net

DR KNIBBS'S book is a valuable contribution to the literature relating to bauxite, and it is therefore very regrettable that the price is so high Nine of the fifteen chapters are concerned with the uses of bauxite, a subject about which published information is rather scanty After a brief account of its occurrence and properties, the uses of bauxite in the manufacture of aluminium and its compounds, alumina refractories, abrasives and aluminous cements, and in oil refining, are all fully described In view of the great increase in the production of aluminium and the growth of a demand for aluminous cements, the possibility of a shortage of bauxite at some future date must be seriously considered, and in the concluding chapter Dr Knibbs discusses the utilisation of clays as substitutes Valuable lists of references are given at the ends of chapters

Notions fondamentales de chimie organique Par Prof Charles Moureu Neuvième édition entièrement revue et augmentée de nouveaux chapitres Pp ix + 657 (Paris Gauthier-Villars et Cie, 1928) 70 francs

THE new French edition of this well known textbook has been revised and brought up to date Several interesting chapters have also been added, dealing with the following aspects of applied organic chemistry substances possessing odour (pp 26) or taste (pp 7), organic medicinals (pp 47) and explosives (pp 14) We may note that the first of the new chapters contains no mention of the striking osmophoric properties of organic sulphur and selenium, and that the revised account of the carbohydrates, which scarcely does justice to recent researches, could be expanded with advantage The book may be criticised in these and other details, but the enlarged version, regarded as a whole, is characterised by the sense of proportion, logical presentation, and clarity of exposition which distinguished Prof Moureu's original text

J. R.

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications*]

An Isotope of Oxygen of Mass 17 in the Earth's Atmosphere

SINCE we reported the presence of an isotope of oxygen with mass 18 in the earth's atmosphere (NATURE, **123**, 318, 1929) we have found further confirmation Mr Harold D Babcock has sent us thirty four lines which were withheld from publication by Dieke and Babcock (*Proc N A S*, **13**, 670, 1927) because it was not known that they were due to oxygen Twenty seven of these are due to the alternate rotation levels of the 18 16 oxygen molecule Thus the 18 16 molecule has every rotation state where the 16 16 molecule has only alternate levels Such an excellent confirmation of the predictions of wave mechanics in this regard has not heretofore been possible since the presence of nuclear spin usually permits all states to exist although not in equal amount The more complete discussion of the data will appear elsewhere (*Jour Am Chem Soc*, May 1929) In the meantime Babcock, who obtained the data at Mount Wilson Observatory, has re examined his plates and also obtained additional measurements He has found a number of extremely weak lines in addition to extending the various 18 16 series, and has kindly permitted us to examine his manuscript in advance of publication (*Proc N A S*)

Babcock suggests that his new lines may be due to the forbidden 16 16 alternate rotation levels, although, as he points out, they fail to occupy the correct positions by several times his experimental error

We have found that these lines originate from a molecule consisting of an atom of mass 17 in combination with one of mass 16 The normal state of this molecule has one half unit of vibration, and both odd and even rotation levels exist Each of these facts is in accord with the theory of wave mechanics

The equations for the isotopic displacement are the same as previously given (NATURE, **123**, 318, 1929) except that 1 11 cm $^{-1}$ and 0 0294 cm $^{-1}$ should replace the values 2 12 cm $^{-1}$ and 0 0556 cm $^{-1}$ respectively Out of 22 new weak lines we find that 19 belong to oxygen 16 17 The algebraic deviation of observed minus calculated lines is $-0\ 03$ cm $^{-1}$ with a maximum deviation of 0 14 cm $^{-1}$

It is apparent from the comment of Aston (NATURE, **123**, 488, 1929) with regard to oxygen 18 that a mass spectrograph is unreliable in an initial or confirmatory investigation of isotopes present in very small amount It appears that the various known isotopes of the elements, their several chemical combinations and multiple ionisations, are not eliminated by existing technique, and suffice to explain nearly any future observation that can be made on an isotope present in very small amount This is, however, not the case in band spectroscopy, where the very characteristic fine structure having been found for an abundant isotope will lead to an equally characteristic counterpart We may thus conclude with certainty that oxygen isotopes 17 and 18 do exist in the earth's atmosphere

Babcock has carried out some very accurate intensity measurements to assist in the estimation of relative amount As we have pointed out in our more detailed paper (to appear *Jour Am Chem Soc*, May 1929) 18 16 molecules may be slightly polar, due to zero point vibration This would be expected, since the centre of mass does not coincide with the geometrical centre Such polarity may increase the absorption coefficient of the 18 16 or 17 16 molecules However, intensity measurements should lead to a maximum value Babcock estimates oxygen 18 as present to one part in 2500 He has, however, over looked a factor of two in his calculation, so that the estimate should be one part in 1250, as a maximum This factor is due to the fact that the 18 16 molecules have twice as many states in which to exist as have the 16 16 molecules

From Babcock's estimate of the relative intensity of the lines which are due to the 17 16 molecule we estimate its abundance as about one part in 10,000 as a maximum

Oxygen mass 17 has been reported by Kirsch and Petterson (*Ark f Mat Astron och Physik*, Stockholm, 19, 15, 1 16, 1925 *Phys Z*, **26**, 457, 1925) and by Blackett (*Proc Roy Soc*, A, **107**, 349, 1925) from data obtained on collisions between alpha particles and nitrogen nuclei These collisions occasionally lead to combination with subsequent elimination of a proton leaving oxygen 17 These experiments did not indicate the stability of oxygen 17, except that Blackett was able to show a life of at least 0 001 sec

A full account of our work will appear elsewhere

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April 27

The Heat Production of Crustacean Nerve

IN my Ludwig Mond Lecture, published in NATURE of May 11, I referred to the experiments of Furusawa on the 'depolarisation' of crab's nerve by stimulation, and to the manner in which the 'polarisation' (as shown by the injury current) increases again to its original value in the presence, but not in the absence, of oxygen In a paper by Furusawa, shortly to be published in the *Journal of Physiology*, it will appear that this recovery process occupies a time of the order of half an hour I have recently succeeded in measuring the heat produced by crab's nerve, as the result of a 5 to 10 seconds' stimulus Some 98 per cent of this heat occurs in the recovery phase, only 2 per cent during the actual stimulus the recovery heat production lasts for 20 to 30 minutes at room temperature There is no doubt, therefore, that the process in which the injury current, diminished by stimulation, returns to its original value is accompanied by a relatively large liberation of energy

A striking fact is the small amount of heat set free in the initial phase, that is, during the passage of the impulse If we regard the nerve wave as accompanied by a surface change in the fibre which momentarily allows electrical contact to occur between inside and outside (it is difficult to picture the 'action current' otherwise), then activity will allow an equalisation of concentration of ions to occur between the two sides, a process which must be reversed during subsequent recovery The mixture of two salt solutions, say of potassium chloride and sodium chloride, involves very little change in total energy considerable work, however, may be required to separate them again, and this work will require a provision of energy, and in any actual process the liberation of heat

The crustacean nerve, as shown by Levin and by Furusawa, is highly fatigable, at any rate in respect of its electric change Corresponding to this, Meyerhof

and Schulz have shown in a recent paper in the *Biochemische Zeitschrift* that its oxygen consumption is high reckoned per gram of *dry* nerve, when stimulated, twenty times as high as that of a frog's sciatic, at rest ten times as high In a short stimulus I have found the total heat (initial plus recovery, spread over half an hour) to be about $2\,5 \times 10^{8}$ calorie per gram of fresh nerve per second of stimulus, as compared with 7×10^{5} calorie for the frog The crab's nerve is non medullated, the fibres of the frog's sciatic consist mainly of medullary sheath this may be one cause of the large difference between the two The fact that the crab's nerve contains a far higher percentage of water would work in the opposite direction

Whether the striking differences in fatigability, depolarisation, recovery, and energy exchanges between those crabs nerves and the sciatic of the frog are simply to be attributed to the fact that the former are non medullated and the latter medullated, only future work can show The central nervous system, which consists largely of nerve cells and to an appreciable extent of non medullated fibres, is far more fatigable and more dependent on an adequate supply of oxygen than is the peripheral medullated nerve It may well be the case that in the limb nerves of the crustaceans we have in such respects a much better model on which to work out the elementary properties of the nervous system than we find in the ordinary medullated nerve, which hitherto has been chiefly used for the purpose

A V HILL

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London, W C 1, May 14

The Inland Waters of South Africa

IN view of the forthcoming visit of the British Association to South Africa, we should like to direct the attention of biologists to certain remarkable inland waters occurring in that country Throughout the southern half of the Transvaal, as well as in many other parts of South and South west Africa, are found shallow saucer like depressions of various sizes which may be filled temporarily or permanently with water These pans have been ably described by Rogers,[1] and are generally admitted to be the result of wind erosion at a time when the climate of the country was drier than it is at present, although Passarge[2] considers them to have been the result of 'zoogenous' erosion in the Kalahari

We have examined a considerable number of these localities both on the Witwatersrand and in the Lake Chrissie region of the Ermelo district, an area of uncertain drainage from the edges of which arise the Vaal, Komati, and Usutu Rivers, and within which a surprisingly large number of pans occur.

From a hydrobiological point of view the Transvaal pans may be divided into temporary and permanent waters The *temporary pans* dry up in the latter part of the winter season, often leaving a few small pools, and fill with the first heavy summer rains They may be referred to the 'astatic' type of Gajl,[3] and normally support a rich phyllopod (s str.) fauna We have found it convenient to subdivide the temporary pans of the southern Transvaal into *grass-pans* and *mud pans* The pH of the former is below 8 0 when full, and the soil of the bottom does not become sufficiently 'brak' to inhibit the growth of a rich terrestrial vegetation on drying When full, such localities support a large number of aquatic flowering plants, and a very abundant and varied tycho plankton, characterised by the association of *Volvox* spp with the rotifer *Conochilus hippocrepis* The *mud pans*, on the other hand, have a pH of more than 8 2 when full, and presumably their floor is too 'brak' when dry to allow the growth of abundant terrestrial vegetation The plankton is far more restricted than is that of the *grass pans*, phytoplankton is almost absent, and rotifers rare, the bulk of the organisms inhabiting such localities being crustacea

In the Lake Chrissie area the majority of the pans are permanent Chemical conditions are very variable and are reflected in corresponding differences in the fauna and flora The most interesting condition was met with in a series of pans, all less than a mile in diameter and perhaps 10 20 feet deep The water of these pans has a pH of about 9 0, is slightly salt (0 02 0 03 *N* Cl), coloured from pale yellow to deep sepia by humic material, and may be very turbid Such pans support practically no higher vegetation or phytoplankton and have a zooplankton composed almost exclusively of one or two species of Centropagid copepods and a large and remarkable Daphniid The largest pans, for example, Lake Chrissie itself, which is about three miles long, may support a rich growth of *Potamogeton Livingstonii* (Moss forthcoming publication) In striking contrast to these pans may be mentioned a pair of pans lying close together on the farm Weltevreden to the south of Lake Chrissie One of these, which is slightly alkaline, supports an exceedingly rich growth of *Melosira* and a few other algæ and is slightly alkaline, the other, which is just on the acid side of neutrality, contained large numbers of desmids and a very rich rhizopod and rotifer fauna

Naumann,[4] in his latest contribution to lake typology, characterises the *dystrophic* type of water as being on the acid side of neutrality, poor in electrolytes and containing considerable amounts of humic matter, while the *oligotrophic* type of Thienemann[5] is divided into *oligotrophic* (s str) on the acid side and *alkalitrophic* on the alkaline side of neutrality The more extreme type of permanent pan containing large amounts of humic matter must be considered as *dystrophic*, but differs from Naumann's characterisation not merely in alkalinity, but also in containing large amounts of electrolytes (chiefly sodium bicarbonate and sodium chloride with some calcium, magnesium, and sulphates), including accumulated phosphates, up to 0 006 mgm P_2O_5 per litre, which cannot be utilised owing to the lack of phytoplankton The poverty of the planktonic flora must be attributed to the combined influences of alkalinity, turbidity, and colour of the water as well as to the direct toxic action of the humic matter Since both acid and alkaline waters may be classified as *dystrophic*, it would seem better to abandon the term *alkalitrophic* type and to revert to Thienemann's earlier scheme, recognising, however, an alkaline as well as an acid phase in the *oligotrophic* and *dystrophic*, if not in the *eutrophic* type Other cases of *alkaline dystrophic* waters are probably recorded in the literature without their true nature being recognised, for example, Turner's Lake, Isle au Haut, Maine[6] Dr S C Ball also kindly informed us that very salt humic waters may occur in the lagoons of coral atolls when completely shut off from the sea In such a case a *salt dystrophic* lake may be formed supporting only a population of *Artemia*

[1] *South Afr Jour Sci*, 19, p 1; 1922
[2] "Die Kalahari", Berlin, 1904
[3] *Bull Int Ac Pol Sci Math* (B), p 13, 1924

[4] 'Grundlinien der experimentellen Planktonforschung. Binnengewässer VI.', Stuttgart, p 24, 1929
[5] Die Binnengewässer Mitteleuropas Binnengewässer I.", Stuttgart, p 199 1926.
[6] Bishop and Clarke, 'A Scientific Survey of Turner's Lake", N Y State Mus., 1923.

Normal acid *dystrophic* waters also occur in South Africa, but are chiefly of artificial origin, for example, the various reservoirs on Table Mt from which the water supply of Cape Town is derived The Transvaal pans by no means exhaust the hydrobiological wealth of the country , on the Witwatersrand are found very acid waters (pH 3 7) contaminated with nitre cake from gold extraction works, which support a restricted fauna The alkaline vleis near Cape Town also deserve passing mention

A detailed report on the chemical conditions and planktonic life of all these localities is in preparation and will be published as soon as our collections have been worked out by the various systematists who have kindly undertaken to examine them Our very best thanks are due to Prof L T Hogben, of the University of Cape Town, who first directed our attention to the remarkable field offered by South Africa for this type of research , to Dr A W Rogers, director of the Geological Survey of South Africa, for bringing to our notice the Transvaal pans, to Prof J A Wilkinson, of the University of the Witwatersrand, who generously placed his facilities for chemical analysis at our disposal, and to Prof C E Moss and his staff, of the same University, and to Miss E L Stephens, of the University of Cape Town, for valuable botanical information

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Vegetation Formulæ

THE value of floral formulæ in indicating at a glance the systematic position and affinities of a phanerogam has so long been recognised that no apology is needed for suggesting that a comparable means of expressing the general character of vegetation types is both eminently desirable and likely to prove of great value to the ecologist and phytogeographer At the present time the personal factor inevitably enters largely not only into the description of vegetation, but also into the interpretation of descriptions After some years of residence in the drier parts of India and Burma the *Acacia* thorn forest and *Acacia* scrub, both with an undergrowth mainly of grass, had become two of the most familiar types of vegetation, yet I was unprepared for the extraordinarily close comparison which is possible with large areas of the Bush Veld of Southern Rhodesia or with certain types of mulga scrub and mallee scrub which I found on visiting South and Western Australia Yet a vegetation formula, such as is now proposed, would have indicated the affinity at a glance It is essential that the formulæ shall be kept as simple as possible, so that they may be used by travellers and explorers with only a slight knowledge of botany, but will at the same time impart a valuable precision to their observations.

The formula depends upon two separate considerations:

(*a*) The enumeration of plants over a definite standard area.

(*b*) The recognition of four or five main groups of plants for this purpose.

It has long been the custom of forest officers to study their forests by 'sample plots' and of ecologists to base detailed descriptions on similar plots. It is proposed that one hectare be taken as the standard area Of course the enumeration may be carried out over any sized area and the results reduced to the standard area Thus a hectare is equivalent to 2 47 (roughly 2½) acres and is equal to 10,000 square metres, so that the enumeration of small plants may be made on the basis of a square metre It is necessary to have a large standard area to cover adequately tropical vegetation where there may be but one or two individuals of a particular species even in a dense equatorial forest, or the widely scattered vegetation of a semi desert

It is suggested that, for practical purposes, the types of plants to be enumerated may be considered as divisible into five broad groups trees (A from Lat *arbor*), shrubs (F from Lat *frutex*) herbaceous plants (H from Lat *herba*), grass (G from Lat *gramen*), and cryptogams (C) It is recognised that *herba* is not a very satisfactory word, but its use in the sense proposed (excluding grass) is already widespread in the adjective herbaceous The basal vegetation formula is thus

$$xA + yF + zH + x'G + y'C,$$

where x, y, z, x , and y are the numbers of individuals per hectare For broad descriptive purposes it will often be possible to ignore C entirely

For trees and shrubs the presence of more than one story may be indicated by duplicating the symbol thus

$$A + A' + F + F ,$$

whilst the general character of the trees or shrub may be indicated by suffixes such as e (evergreen), d (deciduous), c (coniferous) The average height of the vegetation is important and should be expressed in metres For all types of vegetation the letters a, b, c, d, etc , may be used to indicate dominants , x, y, z, etc , to indicate the absence of dominants or presence of numerous species To take a very simple example

$$150\ A^{c}a(30)$$

is the formula for a coniferous forest with one dominant (a), with an average height of 30 metres and averaging 150 trees to the hectare

It is significant of the lack of precision in many of our existing descriptions of vegetation that I have not exact figures for any of the types of vegetation described in my "Vegetation of Burma" (1925) and in the *Journal of Ecology* (1923), but supplying estimates, four types of vegetation may be selected to indicate the use of the formulæ

(1) *Indaing*
$$= 300A^{e}abx(20) + 50F^{e}y + 10^{4}(2Hz + 10Gmnz')$$
(2) *Diospyros* forest
$$= 200A^{e}bcdex(12) + 50F^{e}y + 10^{4}(Hz + 10Gmnoz')$$
(3) *Acacia* thorn forest
$$= 150A^{e}efx(7) + 100F^{e}y + 10^{3}(5Hz + 20Gmnz')$$
(4) *Acacia* scrub
$$= OA + 150F^{e}efy(2) + 10^{2}(2Hz + 5Gz')$$

TREES a = *Dipterocarpus tuberculatus*, b = *Pentacme suavis*, c = *Terminalia tomentosa*, d = *Diospyros birmanica*, e = *Acacia catechu*, f = *Tectona hamiltonii*

GRASSES m = *Andropogum contortus*, n = *A apicus*, o = *A serratus*

It is obvious that the four examples chosen form a continuous gradation (actually the result of decreasing moisture).

If the principle of vegetation formulæ is acceptable to ecologists, numerous refinements and extensions will be necessary, but the present outline scheme is put forward with the hope that it may induce a greater precision of description by travellers It is to be

noted that the formula is at least partially complete without the *naming* of the constituent species, it may also be noted that a formula can be drawn up from a study of scaled photographs, and even approximately in the case of forests from aerial photographs

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Distribution of Temperature in the First 25 Kilometres over the Earth

SIR NAPIER SHAW, in his "Manual of Meteorology", gives on p 100 of vol 2 a very interesting diagram showing the distribution of temperatures in the upper air over the globe. As pointed out by Dr C W B Normand in his review of the book in the *Quarterly Journal of the Royal Meteorological Society* (vol 54, p 275, 1928), the diagram does not represent exactly the peculiarities of the distribution of temperature in the stratosphere over the tropical and sub tropical regions. An attempt has therefore been made to prepare a modified diagram, using all the data now available. It shows (Fig 1) the probable distribution of isotherms in the atmosphere up to 25 km in summer and winter over the northern hemisphere. The dotted lines are based on very few observations and are therefore mainly conjectural. The principal features of the diagram may be briefly summarised

(1) The stratosphere is not isothermal over any particular place, but above a certain level there is a tendency for the temperature to increase with height

(2) The coldest air over the earth, of temperature about 185° A, lies at a height of some 17 gkm over the equator in the form of a flat ring surrounded by rings of warmer air

(3) The surface of the tropopause has a relatively steep slope towards the pole between latitudes 30° and 50° in summer and between 25° and 45° in winter

(4) The ring of lowest temperature at the tropopause is displaced towards the summer hemisphere

(5) There is a ridge of high temperature in the tropopause between latitudes 20° and 40° N in summer corresponding to the ridge of high pressure at 8 km over those latitudes (see Sir Napier Shaw's chart of 8 km isobars in July, *loc cit* p 262)

The evidence for (1) and (2) comes from the results of sounding balloon ascents at Batavia, Agra and in the United States of America (Blair, *Bull Mt Weather Obs*, vol 4, part 4, pp 183 304, 1912). The rise of temperature with height in the stratosphere over these places cannot be considered to be due to insolation, as most of the Agra ascents and many of the American ascents began late in the day when the sun was low. Bemmelen has given strong reasons for believing that the rise of temperature in the stratosphere which he observed over Batavia could not have been due to insolation. The Agra and Batavia results indicate a temperature of about 220° A. at a height of 24 km, and the American results show about 230° A. at 25 km

The seasonal variation of temperature of the tropopause at Batavia and Agra is illustrated in Fig. 2 and shows (4) clearly. The height of the tropopause over

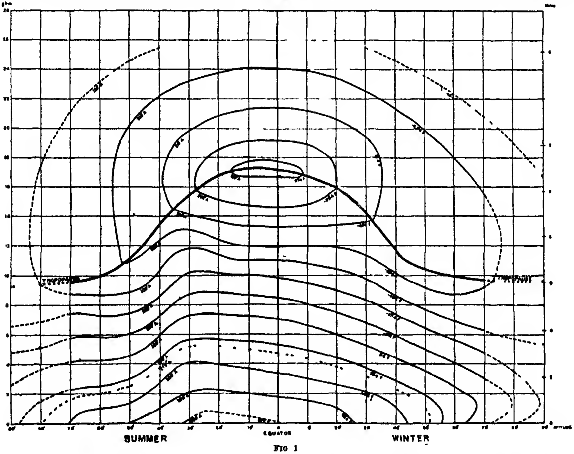

FIG 1

Batavia does not show such well marked variation as that of temperature, but the following figures taken from Bemmelen (*Proc Roy Acad*, Amsterdam,

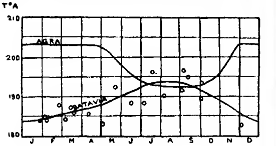

FIG 2 —The points marked in the figure refer to Batavia temperatures

vol 20, p 1313) show that the variation is similar to that which occurs over Agra but displaced by about six months

Heights of Tropopause over Batavia (km)

Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
17 8	17 6	17 3	17 0	16 5	16 2	16 0	16 5	17 0	17 4	17 6	17 7

The lower temperatures and greater heights of the tropopause in summer are presumably due to the stronger convection in the troposphere in that season

The persistent increase of temperature with height for at least 5 km above the tropopause in the tropics finds a natural explanation if we assume that the tropopause marks the lower limit of the ozone layer in the atmosphere K R Ramanathan

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Significant Figures in Speed Records

I had hoped that someone more competent than myself would have replied to Col O'Gorman's letter, in which, in Nature of Mar 30, he offered an apologia for recording Sir Henry Segrave's speed to 8 significant figures, but probably most readers of this journal do not consider that motor speed records form a subject with which they are intimately concerned It would, however, be regrettable if this silence led the general public to conclude that scientific workers are prepared to accept as valid a speed recorded to one hundred thousandth part of a mile per hour

Col O'Gorman commences his letter by admitting that the last figures are merely arithmetical residues, with which all will agree, but unfortunately in what follows he seems to attempt to justify the inclusion of these readings in the published value of the speed and to this objection may fairly be taken His first argument is based on the necessity for great precision in order that there may be no doubt whether a standing record has been beaten by a subsequent attempt or no Let us examine this argument a little more closely Sir Henry Segrave's mean time for the mile over his two runs was 15 56 sec, the automatic timing being carried to 1/100 sec, and the mile apparently assumed to be absolutely accurate A subsequent claimant to the record may do one of the following five things

1 He may beat the record by a substantial margin, in which case a statement to the nearest mile per hour would clearly be sufficient

2 He may beat it by a narrow margin. We will take the nearest margin which can be recorded, one-half of one hundredth of a second (the time being the mean of two runs each of which is measured to 1/100 sec) This will make his time 15 555 sec, and his speed 231 44 miles per hour (or if we give the arithmetical residues, 231 43683 m p h)

3 He may take precisely the same time to the half hundredth of a second as Sir Henry Segrave (15 56 sec) with a speed of 231 36 miles per hour

4 He may take one half hundredth of a second longer when his speed will be 231 29 miles per hour

5 He may fail to obtain the record by a substantial margin

Now in cases 2 and 4, to determine whether the claimant has obtained the record or not, it is amply sufficient to record the speed to 1/100th of a mile per hour The difference from the standing record in each case amounts to 0 07 or 0 08 mile per hour In case 3 no addition to the number of significant figures will serve to distinguish between the new record and the old It is difficult to find any support for 8 significant figures from these facts

Col O Gorman next points out that the speed published is not the true mean of the speeds obtained on the two runs over the measured distance, but the sum of the two distances divided by the sum of the two times It is not clear how this fact affects the question of the permissible number of significant figures which is governed solely by the accuracy with which the time and the distance can be measured One may further ask why, if it is wrong to round off to two decimal figures, it is right to stop at five figures? Why not publish a whole page of decimals?

It would perhaps be presumption on my part to suggest a line of defence which Col O'Gorman might have adopted, which could not be assailed on the scientific side He might have pointed out that these speeds to be accepted internationally must be worked out in the manner laid down by the international controlling body, and that any country which attempts a record and wishes its claim to be recognised must follow the prescribed rules The Royal Automobile Club, therefore, would be under an obligation to give the prescribed number of figures whatever this number might be It may publish a foolish statement, but no alternative is open except that of not claiming the record, and few people would wish to push the claim for scientific honesty to this length

J S Dines

78 Denbigh Street,
S W 1

The Spread of Scale Insects and their Parasites

Many years ago I was an industrious collector of scale insects and mealy bugs, especially in Jamaica I found them in great abundance on cultivated plants, and obtained many species When recently travelling in the Oriental tropics, I was struck by the relative scarcity of these insects, and the occurrence of various well known injurious forms only in small patches or isolated individuals Perhaps the difference was partly due to the relative poorness of my eyesight, but I could not help speculating on the causes which might lead to a diminution of scale insects on cultivated plants, aside from the operations of economic entomologists World wide commerce has spread the injurious Coccidæ over the earth, as they are so easily carried with plants In their native countries they are efficiently controlled by parasitic and predatory enemies In several well-known cases a plague has been abated by going to these countries and obtaining the natural enemies, which had failed to arrive with the first (accidental) importation of the coccids Thus, following the modern expansion of trade and rapid transit, there has been in many regions a great increase in the damage done by scale insects, at times reaching the magnitude of a calamity But by the same process,

gradually but surely, the natural enemies will also spread In the course of time, almost imperceptibly, they will gain the ascendancy, and the coccid plague will cease, never to return unless through the importation of a new sort of coccid Thus it may even happen in some cases that a rigid quarantine, after a pest has arrived, may be harmful, preventing natural enemies from following it These latter may, however, be brought in by entomologists, through special permission, provided they have been found and recognised

There is some proof that this is not mere speculation I wrote to Dr L O Howard, who has long paid special attention to the parasites of Coccidæ, and he directed my attention to a study he had made, comparing the scale insect parasites of the United States (Chalcidoidea) with those he had studied and described in 1880 There was no doubt that in the years since that date the parasite fauna had changed owing to the introduction of many foreign species, which had in some cases supplanted native ones Furthermore, the recent researches of Garcia y Mercet in Spain, and Silvestri, Masi, and Paoli in Italy, indicated the existence in great numbers, in the Mediterranean region, of Aphelinine parasites apparently unknown there seventy five years ago Last year, when I visited the Melbourne Botanic Garden (which has about 16,000 species of plants growing in the open), Mr St John informed me that there were not nearly so many coccids on the plants as formerly This may partly be due to native enemies, thus the Red Wattle bird keeps the fluted scale (*Icerya purchasi*) in check, yet I suspect it may also be due largely to the spread of foreign parasites

Similar-looking coccids may have quite different natural enemies The citrophilus mealy bug (*Pseudococcus gahani*), though an ordinary looking species, was not controlled in California by the many enemies of the native American mealy bugs Now, after an extended search, *Pseudococcus gahani* has been found apparently native in Australia, and two species of Hymenopterous parasites, a Dipterous parasite, two kinds of Coccinellid beetles, and a Chrysopa have been observed to keep it within bounds in that country These have now been taken to California, and there are already indications of favourable results California's plant quarantine would have prevented them from coming over accidentally, and in any case the deliberate work of the entomologists is infinitely superior to the slow operations of chance

T D A Cockerell

University of Colorado,
Boulder, April 22

Variation of the Intensities in the Helium Spectrum with the Velocity of the Exciting Electrons

Recently, Peteri and Elenbaas (*Zeits f Phys*, **54**, p 92 1929) have published curves of the intensity variations of the helium lines when the velocity of the exciting electron steam is altered We have been working on the same subject, and since our results do not agree with theirs, it seems worth while to give a preliminary account of them

We also use a photographic method of measuring the intensities, but the apparatus for exciting the light is different A narrow electron beam in helium at 0·024 mm pressure passes into a field free box and produces a narrow streak of light An image is thrown on to the spectrograph slit and runs perpendicular to it We integrate the intensity over the length of the spectrum lines and subtract the background which is due to secondary excitation In this way we completely avoid errors due (1) to secondary excitation, and (2) to the variation of the spatial distribution of the electron beam with the applied voltage

The results for the lines 3889 ($2^3S - 3^3P$) and 3965 ($2^1S - 4^1P$) are shown in Fig 1 The scale for the two lines is arranged for the maximum of the two curves to be equal The results of the Utrecht workers are shown dotted for comparison We cannot explain their curves except by the supposition that a large fraction of the light from their tube was due to excitation by secondary electrons

The interesting feature of our curves is the extremely different behaviour of the singlet and the

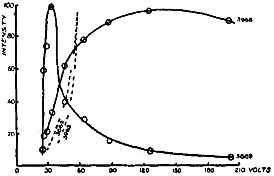

Fig 1 —Intensities in the helium spectrum

triplet lines This is a general characteristic of all the lines, though individual cases show minor variations The following conclusions may be stated

(1) For high exciting velocities, the triplets vanish in intensity compared with the singlets This has been predicted theoretically by Oppenheimer, and had previously been found experimentally by Hughes and Lowe (*Proc Roy Soc*, A, **104**, p 489, 1923), with whose results ours agree very well in general

(2) For low exciting velocities, the singlets are weak compared with the triplets This is a new result Since the normal state of He is a singlet state, this seems to indicate for low velocities a very close coupling of the spin of the exciting electron with the spins of the electrons in the atom

There is another interesting point of dissimilarity between the singlets and triplets We find that while the light of the triplets is confined closely to the electron beam, the light from the singlets tends to spread away from it This makes the intensity determinations of the singlets somewhat arbitrary We are not at the moment prepared to discuss the cause of this behaviour as the investigations are not yet complete

J H Lees
H W B Skinner

H H Wills Physical Laboratory,
The University, Bristol,
May 7

The Longitudinal Distribution of Photoelectrons

The new quantum mechanics has completely resolved the problem of the photoelectric effect. In fact, Wentzel (*Zeit für Phys*, **40**, 574, 1926 **41**, 828, 1927) and Beck (*Zeit für Phys*, **41**, 443, 1927) have succeeded in justifying theoretically the well known Einstein equation, and the more complete treatment of Sommerfeld has permitted the calculation of the dissymmetry of the photoemission, that is, the experimental fact that the forward emitted electrons are in a greater number than the backward ones. Sommer-

feld's theory is, however, a first approximation, valid only when the wave length λ of the incident rays is fairly large compared with the dimensions of the atomic radius. With these conditions, considering electrons emitted from the K level, the probability $P(\theta)d\theta$ of emission of a photoelectron at an angle comprised between θ and $\theta + d\theta$ is proportional to

$$\left\{1 + \frac{18}{5}\frac{v}{c}\cos\theta\right\}\sin^2\theta d\theta \qquad (1)$$

and the mean impulse σ acquired by the electrons in the direction of the propagation of the rays is given by

$$\sigma\frac{h\nu}{c} = \frac{18}{5}\frac{4}{10}\frac{h\nu}{c} = 1.44\frac{h\nu}{c}$$

Williams (NATURE, April 13, 1929) has demonstrated that this formula is in agreement with the experimental results, because recent experiments made in nitrogen and in oxygen lead to a value of σ ($\sigma = 1.40$), nearly equal to the theoretical one.

Equation (1) is, however, only a first approximation, and it remains to be determined what is the formula of distribution valid when Sommerfeld's approximation is not enough. We have made the calculation for the K level without any limitations for the value of λ. We have obtained a very complicated formula, that in a first approximation, when

$$\lambda \gg \frac{h}{2mc}$$

gives the (1), and in a second approximation leads to the following expression

$$\left\{1 + \frac{18}{5}\frac{v}{c}\left[1 - \frac{135}{56}\frac{RhZ^2}{mc^2} + \frac{45}{112}\frac{v^2}{c^2}\right]\cos\theta\right\}\sin^2\theta d\theta$$

where R, h, m, c, and Z are well known constants.

Substituting for those their values, we have

$$\left\{1 + \frac{18}{5}\frac{v}{c}[1 - 6.41 \times 10^{-5}Z^2 + 0.40]\cos\theta\right\}\sin^2\theta d\theta \qquad (2)$$

According to (2), in the second approximation we have a variation from Sommerfeld's value, depending upon the atomic number Z, but of little entity, and a greater variation from the velocity of the photoelectron in the opposite sense. The agreement obtained in the case considered by Williams remains also in the second approximation. In fact, for nitrogen ($Z = 7$) irradiated with rays of $\lambda = 0.6$, the ratio v/c is equal to 0.28, and formula (2) gives for σ quite the same value as formula (1) ($\sigma = 1.41$).

The deviations from the value of σ calculated by (1) are sensible for the heavier elements. In fact, if one obtains with $v/c = 0.1$, $\sigma = 1.40$ for argon ($Z = 18$), which is a value a little different from that of Sommerfeld, for krypton ($Z = 36$) one obtains $\sigma = 1.33$.

For very hard rays the effect of the second order, depending on the velocity, is more conspicuous. So if v/c is equal to 0.6, one obtains for argon $\sigma = 1.61$, and for krypton $\sigma = 1.53$. These values are not in agreement with those obtained by Auger for argon.

Further experiments may decide this question.

Details of the calculation will be published elsewhere.

ANTONIO CARRELLI.

Istituto Fisico, R. Università,
Napoli, May 3.

Dragonflies in Folk-lore.

IN recent years NATURE has adopted the very interesting departure of taking notice, by review or otherwise, of contemporary novels which hold some special interest for science, either (as in the case of H. G. Wells's "William Clissold") because of the recognised biological outlook of the author, or (as in the case of Aldous Huxley's "Point Counterpoint") because of some exceptionally expressed criticism of modern science, its aims or its outlook.

This attitude might well be adopted also towards novels which contain accounts or records of the popular outlook in times past towards natural objects, whether living or inanimate. Recently it has been my good fortune to read a novel which has already been acclaimed as a modern masterpiece, namely, the late Mary Webb's "Precious Bane". It is full of quaint archaically expressed observations of Nature in the countryside. The time is about the end of the Napoleonic wars. The chapter on dragonflies (book 3, chap. v.) is well worth reading from this point of view alone, and I would like to ask readers of NATURE whether any of the expressions in the following passage are still in use in Great Britain:

We called the dragonfly the ether's mon or ether's nild at Sarn, for it was supposed that where the adder or ether lay hid in the grass, there above hovered the ether's mon as a warning. One kind, all blue, we called the kingfisher, another one with a very thin body the darning needle. Mother was used to tell Gideon that if he took dog's leave or did other mischief the devil would take needle to him and use the dragonflies to sew up his ears, so he couldna hear the comfortable word of God and would come to damnation. But I never could believe that the devil could have power over such a fair thing as a dragonfly.

I believe dragonflies are still quite commonly called 'devil's darning needles' in many parts of the United States of America, but whether the adder is still called the 'ether', or the dragon fly the 'ether's mon' or 'ether's nild' in any part of England or America I do not know. Perhaps some readers of NATURE could enlighten me.

The species called the 'kingfisher' would evidently be *Calopteryx virgo* L., while the 'darning needle' must have been either *Agrion puella* L. or some other common damsel fly, perhaps *Enallagma cyathigerum* Charp.

R. J. TILLYARD.

Canberra, F.C.T.,
Australia, Mar. 31.

Periodic and Spiral Forms of Crystallisation.

IN a recent letter to NATURE (April 20, p. 603), Hughes has suggested that the interesting spiral markings on carborundum reported by Menzies and Sloat (Mar. 9, p. 348) may be a special case of periodic crystallisation. Hughes refers to a remark in a paper by Miss Henley and myself (*J.C.S.*, 2725, 1928) concerning the formation of spirals in Liesegang rings as anomalies caused by accidental external conditions.

The periodic crystallisation of thin films of sulphur described by Hughes was previously investigated by Fischer Treuenfeld (*Kolloid Z.*, 16, 109; 1915) and by Kohler (*ibid.*, 17, 10; 1915), and an account of this and other examples of the same phenomenon is given in Hedges and Myers' "Physico-chemical Periodicity" (Arnold and Co., 1926) on pp. 34-37.

Some months ago I carried out some experiments on the crystallisation of thin films of molten organic substances and found that crystallisation in concentric rings readily takes place with benzil, benzoin, benzophenone, menthol, *m*-dinitrobenzene, and acetanilide. The experiments were discontinued, but I hope to return to them shortly: at present, the observations made are in the main in agreement with the views expressed by Hughes on the cause of the phenomenon.

I have examined the specimens to see whether there is any indication of the occasional formation of spirals in place of the usual concentric rings. The accom-

panying photograph (Fig 1) clearly depicts the spiral growth of crystals This specimen was made in Sir Henry Miers' laboratory at Manchester in 1924 by allowing a thin film of potassium dichromate solution to evaporate on a warm microscope slide The structure differs from that of the specimen of sulphur in Hughes s illustration and from most of my specimens, in that crystallisation started from the periphery of the drop and travelled inwards, instead of beginning

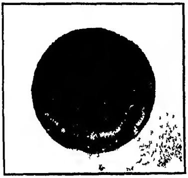

FIG 1 —Spiral crystal growth × 25 diameters

at a central nucleus and radiating outwards The specimen of carborundum described by Menzies and Sloat may have crystallised in this way

Where crystallisation starts from a central nucleus, I have not observed among the specimens an example of the immediate development of a spiral, but I have a specimen of camphorsulphonic acid, crystallised from ethyl acetate solution, in which a true spiral succeeds two concentric rings surrounding the nucleus of crystallisation Moreover, examination shows that a disturbance has been caused at the point where the spiral begins by the presence of another nucleus in the vicinity

There appears to be no doubt, therefore, that crystallisation does sometimes follow a spiral course to give a variety of periodic structure, and it seems probable that the markings on carborundum are to be explained in this way ERNEST S HEDGES

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Regent's Park, N W 1

The Atomic Weight of Phosphorus

IN a recent issue of NATURE (Mar 9, p 390) mention is made of the fact that the English Commission on Atomic Weights adopts for the atomic weight of phosphorus the value 30 98(2), this being based on Aston's results with the mass spectrograph, whereas the German Commission adheres to the older and higher value 31 02, derived mainly from gravimetric analysis

The following results, obtained by the physico chemical method of density and compressibility as applied to phosphine gas, may therefore be of interest

Density L_0^{760} at one atmosphere, 1 5317

Density L_0^{760} at one half atmosphere, 1 5243

Assuming the compressibility factor to be a linear one, the value for $(1+\lambda)$ so obtained is 1 0097, which, in conjunction with the values for oxygen of 1 4290 for the normal density and 1 0009 for $(1+\lambda)$, leads to the molecular weight of 34 00(2) for phosphine and to 30·97(9) for the atomic weight of phosphorus

Further experiments are being carried out at the pressures of three quarters and one quarter atmosphere, to ascertain whether the compressibility can be taken as a linear function of the pressure Such results as have been obtained at one quarter atmosphere give the value $L_0^{760} = 1\ 5208$ for which $(1+\lambda) = 1\ 0096$ and P = 30 98(2) MOWBRAY RITCHIE

Department of Chemistry,
University of Edinburgh,
April 30

The Atomic Weight of Copper

WITH reference to the Research item in NATURE of April 27, p 660, that Messrs Richards and Phillips have recently found the atomic weight of copper to be 63 557 (Ag = 107 88), it may be interesting to note that the spectroscopic value given in my "Analysis of Spectra" (p 127) is 63 5569 ± 0 060, the 0 06 referring to maximum possible errors The probable error is much less The value obtained on spectroscopic data depends on the doublet separation and the $p(1)$ term These are known with very great accuracy in both silver and copper

W M HICKS

Quantum Geometry

DIRAC'S wave equation for the electron involves a Hamiltonian linear in the momenta p_k This fact seems to be of geometrical nature and suggests the introduction of a linear fundamental differential form

$$ds = \sum_k \gamma_k dx_k$$

with matrix coefficients γ_k in geometrical considerations

This linear ds is connected with Dirac's wave equation in the same way as the Riemannian ds^2 with the relativistic wave equation of the older theory

The matrix vector γ_k may be interpreted as an operator corresponding to the fundamental velocity, namely, that of light, and is connected with the Einsteinian $h_{\nu a}$ by the relation $\gamma_\nu = \sum_a h_{\nu a} \gamma_a^0$ where γ_a^0 are Dirac's constant matrices

Possibly other tensors of the second rank, like the energy tensor T_{ik}, or R_{ik} are to be replaced in the proposed 'linear geometry' by matrix vectors in the same way as g_{ik} is replaced by γ_k

The linear geometry seems to furnish a basis on which a uniform theory of gravitation, radiation, and quantum phenomena is to be constructed More detailed considerations on this subject will appear in the *Zeit f Physik* V FOCK
D IWANENKO

Physical Institute of the University,
Leningrad, Mar 21

Early Use of Iron

THE early history of iron outlined in the address by Prof Louis (NATURE, May 18, p 762) has been carried much further back by discoveries in South Palestine, published in *Gerar* last year Furnaces were found dated to 1100 and 1175 B C, the earlier was 67 in × 36 in At the side of the furnace lay great hoes, 11 in × 5 in, plough socks, and a pick of 6 pounds weight, showing that iron was as commonly used then as now The earliest example was a knife of 1350 B C, and this accords with the date of the polished steel dagger of Tutankhamen This year another steel dagger, with cast bronze handle, has been found, of about 1300 B C, as it was snapped in two anciently without any bending, it could not be soft iron FLINDERS PETRIE.

University College, W C 1

Einstein's and other Unitary Field Theories An Explanation for the General Reader

By Prof H T H PIAGGIO

I

THE announcement of the publication of Einstein's new theory has aroused great interest even among those who do not usually follow the advances of science Unfortunately, this interest has been accompanied by a feeling that the new theory, like Einstein's earlier ones, is a mysterious mixture of metaphysics and mathematics, so obscure and paradoxical that the average man cannot possibly acquire any notion of what it is all about Indeed, a French author declared that " when two German professors meet, and each can understand what he says himself, but cannot understand the other, they are said to be talking Metaphysics If, however, the subject of discussion is so profound that they are unable to understand not only each other, but even themselves, it is called the Higher Metaphysics Now Einstein's Theory belongs to the Higher Metaphysics "

The purpose of the present article is to dispel such views By going back to the work of Newton and Maxwell we can trace the general nature of the ideas that have been uppermost in Einstein s mind It will be shown how the desire for unification of apparently different physical phenomena was the guiding force in each case Other attempts at unification of gravitation and electromagnetism will be explained and contrasted with Einstein's It is hoped that, by simple considerations concerning the meridians and parallels of longitude on the earth's surface, readers without any mathematical knowledge may be able to grasp the general nature of the principles underlying the new geometries

NEWTON AND GRAVITATION

When Newton (1642–1727) started to consider the subject of planetary motions, he found in existence fairly accurate knowledge of the facts, but only the wildest speculations as to the underlying causes Thus Kepler (1571–1630), by analysing the astronomical observations of Tycho Brahe (1546–1601), had found three laws of planetary motion One of these was that the orbits were ellipses with the sun in the focus Kepler even guessed that universal gravitation might have something to do with these laws, but he also considered them as partly due to a magnetic force set up by the sun's rotation Descartes (1596–1650) thought that space was filled with vortices of ether, and the planets were dragged round by these vortices like sand particles in a whirlwind

It was Newton's magnificent combination of physical intuition and mathematical power that enabled him to sweep aside these vague ideas, and to set up what we may call a unitary theory, which explained on a single basis effects hitherto believed to be due to more than one source He showed that gravitation alone, acting between every two particles of the universe with a force proportional to the product of the masses divided by the square of the distance between them, was sufficient to account for all the phenomena of planetary motion It is interesting to notice that at first Newton's theory of gravitation appeared to be disproved by the observed facts concerning the moon and the earth This caused Newton to put aside his ideas for several years When a more accurate set of observations was available the theory was vindicated Its substantial correctness is conclusively proved every year by the truth, to a very close approximation, of the astronomical predictions of the *Nautical Almanac*

MAXWELL AND ELECTROMAGNETISM

We now come to the twin sciences of electricity and magnetism The investigation of their mutual relationship was due to several investigators, among whom Faraday (1791–1867) takes a prominent place Then came Maxwell (1831–1879), who, in what are now well known as Maxwell's Electromagnetic Equations ", gave mathematical form to Faraday's ideas and extended them Maxwell's theories, which united electromagnetism and light, were criticised at the time, and even Lord Kelvin was of opinion that " up to the present the so-called Electromagnetic Theory of Light does not seem to have accomplished much " One term in Maxwell's equations (representing what is called a displacement current) seemed to owe its origin to an illegitimate union of mathematics and metaphysics Worst of all, there seemed no experimental verification of the consequences of the equations This was not forthcoming until after Maxwell's death, and was due to Hertz (1857–1894) The electric waves the existence of which was implied by Maxwell's equations were actually produced, and they may now be received every night by the millions who listen to radio concerts

EINSTEIN'S SPECIAL THEORY (1905)

Long after Maxwell's equations had been firmly established for a fixed system, there was grave doubt as to how they should be extended to a moving one In order to explain the results of the famous Michelson Morley experiment, FitzGerald and Lorentz introduced the remarkable hypothesis of a contraction caused by motion Einstein (1879–   ) showed that the phenomena could be accounted for on the basis of the hypothesis that the velocity of light and all other electromagnetic phenomena would be exactly the same for two observers who were moving with uniform velocity relative to each other This was based on the measurement of time by light signals, an idea which seemed fantastic in those days, but an equivalent idea, the fixing of time by electromagnetic signals sent out by radio from Daventry or Paris, has now become a commonplace in many households

Those who scoffed at the idea of time being any thing but an absolute quantity must now see that it is at least possible that the clocks regulated by

the radio signals from the Eiffel Tower, based upon observations at the Paris Observatory, might not agree exactly with those sent out from Daventry and based on observations at Greenwich This discrepancy, conceivable in any case, would become more so if France and the Eiffel Tower were moving away from Daventry with enormous velocity But the contraction of rods and the slowing down of clocks, to which so much attention has been directed, are (as pointed out by Eddington) only apparent Nothing really happens, except that each observer is unable to get an accurate idea of what length and time really are in the other system The only accurate way to take measurements in a system is to travel with it, and if this is impracticable, as in the case of an electron moving with a speed which is an appreciable fraction of that of light, our measurements of both space and time concerning the electron are slightly different from what they would have been if we could have travelled with it These slight differences are related to each other This is what we mean when we say that space and time form a four dimensional continuum

There is no need to try to imagine a fourth dimension, but calculations, to be accurate in the case of high velocities, must deal with time as well as with the three dimensions of space In this sense the theory united space with time, and so was a unitary one It also united electricity more closely with magnetism, for it showed that what appears to be a purely magnetic field in one system will appear to be a purely electric field in another system moving relative to the first Moreover, it united mass (inertia) and energy, showing that one can be transformed into the other This has since been confirmed in the case of the helium atom, the mass of which is slightly less than the sum of the masses of the nucleus and the electrons which compose it The discrepancy is made up by the potential energy stored up when the electrons and nucleus are packed closely together

In spite of this discussion of mass and energy, we can say broadly that Einstein's Special Theory was fundamentally an electromagnetic one, having no connexion with gravitation Its experimental basis was a slender one, and even such as it is, it has been called in question by Miller, who claims to have obtained, at great distances above sea-level, evidence of the ether-drag of which Michelson and Morley, at about sea-level, found no trace (In spite of the elaborate precautions against error that Miller took, there is a general disposition to reject his results) Perhaps the chief service rendered to science by the Special Theory was the help it gave in arriving at the general one, with which we will now deal

Physical Basis of Einstein's General Theory (1915)

In the dynamics of Newton, the same number, the *mass*, appears to measure three entirely different properties, namely, the quantity of matter, the inertia (or difficulty of setting it in motion), and the weight (the force exerted on it by the earth) Is this merely a marvellous coincidence ? Einstein thought not, and inferred that inertia and weight are probably two aspects of the same phenomenon, due to something in the nature of space (or rather of space time) Again, everyone knows the queer feeling of falling when a lift starts to descend, or of heaviness when a descending lift is coming to rest Weight, in fact, seems to alter when in a system, like a lift, which can be accelerated

This suggests a connexion with relative motion, which, for uniform velocity, was considered in the Special Theory These considerations led Einstein to seek hypotheses concerning space and time which would incorporate the results of his former theory and at the same time account for inertia and gravitation In other words, he was led to seek a new geometry

Abstract and Physical Geometry

How can there be a new geometry ? Most of us had it fixed in our minds that geometry was a fixed and unalterable science Did not Euclid, starting with axioms that were self evident truths, reach conclusions which will stand for all time and, moreover, can be verified by sufficiently careful drawing ? This is certainly what we gathered from Blank and Dash's "Geometry for Schools", but it rests upon a confusion of ideas

First of all, there are two distinct kinds of geometry, abstract and physical The first starts with certain *undefined* terms, such as point, straight line, and plane, and makes certain *unproved* statements, called axioms (or postulates), about them Then we deduce consequences from these definitions and axioms, which constitute abstract geometry The whole structure is purely a sort of building game, in which the definitions and axioms, taken more or less at random, furnish the bricks, and we see what we can build with them There is no necessary connexion with the physical world, and so it is meaningless to inquire whether the axioms are true or self evident To vary the metaphor, they are the rules of the game, and may be changed at will if we want to construct a new game Euclid's geometry in its ideal form, when it reasons entirely from the definitions and axioms (an ideal not realised in any school geometry), is one system of abstract geometry But so long as the science is only an abstract one, we are at liberty to start with a set of axioms quite different from those of Euclid We shall see later that by studying the properties of a sphere we can build up a system called Riemannian geometry, of which Einstein makes great use

We now come to physical geometry, the science that deals with the results of the draughtsman, the surveyor, and the architect, and expresses the properties of rulers, set squares, plumb-lines, and other physical objects Of course, Poincaré was right when he asserted that we can assume any system of geometry we like (and no doubt most of us prefer the simplest, namely, Euclidean), and then explain any observed physical phenomenon, however strange, by attributing it to some physical force However, Einstein preferred to proceed otherwise, and exercised his free choice of an

abstract geometry in such a way as to sacrifice some of the simplicity in the geometry to gain as much as possible in the physics For example, in his theory there is no need of a gravitational force to make a planet move in its orbit, for this orbit is as natural in his geometry as is a straight line in the geometry of Euclid and Newton This is what is meant by 'the geometrisation of physics', and we may define physical geometry as that one of the many possible systems of abstract geometry which is most successful in giving a simple account of physical phenomena The experience of draughtsmen and others shows that Euclidean geometry works very well indeed in ordinary terrestrial affairs, so physical geometry cannot differ very much from Euclidean

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The Origin of Adaptations[1]

By Dr E J ALLEN, F R S

BY an adaptation is meant nothing more than a character of an organism, which has enabled a species to survive itself as such, or to survive until it is transformed into another species It is survival that gives the measure of the value of the adaptation Survival can only occur if the whole organism is adapted to the environment to an extent that suffices Organism and environment must be thought of as a unity, as interlocked and fitted closely to form that harmony which is Nature and life Organic evolution is a phase—the crowning phase, may be—of cosmic evolution The biological environment determines survival no less than the physical, and adaptation to both must be sufficient The environment is not fixed, but must be thought of as in a condition of perpetual flux and change This is true especially of the biological environment, for species once common may practically disappear, and years later may reappear abundantly with devastating effect on other organisms

The general physical conditions under which organisms live have been well discussed by L J Henderson in his book "The Fitness of the Environment" (1913) Henderson discusses the unique properties of water, carbonic acid, hydrogen, and oxygen, and shows how they are specially fitted for the purposes of organic life "There are no other compounds which share more than a small part of the qualities of fitness of water and carbonic acid, no other elements which share those of carbon, hydrogen, and oxygen" "None of the characteristics of these substances is known to be unfit or seriously inferior to the same characteristics in any other substance" "The fitness of the environment is one part of a reciprocal relationship of which the fitness of the organism is the other"

Darwin's answer to the question, how does the adaptation of organism to environment come to be, was based on three factors—heredity, variation, selection In ultimate analysis the fact of heredity depends on the cellular structure of organisms and the phenomenon of cell division When a living cell divides, its most essential substance, the germ plasm, separates into two portions which are almost equal But we cannot so easily obtain an insight into the problem of variation For simplicity's sake, consider first the formation of a germ cell from its mother cell in an organism which is developing parthenogenetically The researches of the colloid chemist have given us the picture In imagination enlarge the germ mother cell until you see the two phases, the liquid, the mass of molecular aggregates varied in size and shape, until you see the long, complex chains of atoms, building up the heavy molecules which form the aggregates, until you see the solar systems in miniature of protons and electrons which are the atoms—a seething, churning mass, active with the activity of cosmic forces, receiving matter and energy constantly from the surrounding medium, and giving them back The preparations for cell division begin, the molecular aggregates arrange themselves in new patterns, the separation of the cell into two parts ensues Is it a matter for surprise that the partition of pattern and of substance is not always, perhaps is never, exact? We cannot wonder that germ cells thus produced differ in small respects among themselves A few molecules more or less, a few atoms more or less, a few electrons even more or less, may mean large changes in the offspring into which the germ cell grows We are, I think, safe in concluding that lack of equality in the partition of the hereditary material is one important cause of variation If we think on similar lines of sexual development, where instead of one we have two germ cells uniting to form the zygote from which the offspring is developed, the probability of variation between parent and offspring, and between different offspring of the same parent, is obviously much increased

Weismann was the first to draw a clear and sharp distinction between true hereditary characters and modifications of the body or soma, produced by the direct action of physical changes in the environment, and to develop the conception of the continuity of the germ plasm The germ plasm is the transmitter, in unbroken continuity from generation to generation, of hereditary qualities The body or soma is its temporary guardian, perishing when the work of transmission has been done Blastogenic characters, as Weismann called the true hereditary characters, reappear in exactly the same form in the offspring as they show in the parent, provided both parent and offspring have grown up in the normal environment Few now question that the nucleus is the essential organ of the germ cell which is engaged in the transmission of hereditary characters Few

[1] Extracted from the Hooker Lecture, delivered before the Linnean Society of London on Mar. 14

also question that the chromatin of the nucleus is the bearer of definite factors or genes, or that these factors are distributed in linear order in the chromosomes which appear at the time of cell division In ordinary normal development, hereditary characters are determined by the factors in the germ plasm in response to stimuli furnished by the environment, for in the absence of a suitable environment no development at all takes place If the environment is normal the characters are reproduced in normal form

Hereditary *variations* are differences from the parental characters, which appear in the offspring, and are transmitted by the offspring to its descendants We can only study them when the environmental conditions, in so far as they affect the characters concerned, remain unchanged throughout the growth of both parent and offspring and this is the recognised basis of all breeding experiments These hereditary or blastogenic variations we now call mutations, and mutations, according to the most recent usage of the word, may be either large or small, it being quite impossible to distinguish them from any other variations by the factor of size alone In this respect the word mutation as now used does not convey exactly the same idea—it is not so limited—as Darwin's words 'sport' or 'monstrosity', and its meaning has been somewhat changed since it was first introduced by de Vries The modern view is that mutations are heritable changes in the characters of organisms, which are due to definite alterations of the factors or genes, situated in the chromosomes of the germ cells Contrasted with these mutations we have somatic modifications, the acquired characters of Weismann, the reaction of the organism to definite changes in the environment De Vries's term 'fluctuations' is now generally employed in the same sense, and has, I think, ceased to be useful

The variations or deviations revealed by the measurements of biometricians, which group themselves around a mean or modal value, according to the 'law of error', are probably in part small mutations which can be transmitted to descendants, and in part somatic modifications which are not so transmitted With adequate measurements for a series of consecutive generations, the statistical tests which the biometrician applies enable him to say whether or not any of these deviations are inherited, and to give a measure of that inheritance To take an example, it is frequently maintained that Johannsen's experiments with garden beans (*Phaseolus vulgaris nana*), which multiply by self fertilisation and from which he obtained what he regards as pure lines, have proved that individual differences as shown by these lines are not inherited, and that therefore they cannot provide material upon which natural selection can act Pearson, however, maintained, so long ago as 1910, that the pure line theory demands that the offspring shall be as highly correlated with the grandparent as it is with the parent, whereas Johannsen's own figures show that the coefficient of correlation between offspring and parent is higher than that between offspring and grandparent These experiments should be repeated with larger numbers of measurements

Mutations may be classified into 'combination mutations', those due to rearrangement of factors or genes already present, and 'alteration mutations' due to changes in the factors themselves Evidence is now forthcoming that the germ plasm itself can be acted on by physical and chemical forces in the environment in such a way that mutations are produced Heslop Harrison's work on the production of melanic forms in Geometrid moths was described (see NATURE, Jan 22, 1927, p 127) This work is of outstanding interest, not only on account of the fundamental importance of the results attained, but also for its perfect combination of acute and penetrating observations in the field with critical and long sustained experimentation Harrison has shown quite clearly that the germ plasm can be changed by chemical substances contained in the food of an animal, or in more general terms that the germ plasm can be altered by the environment Another important advance in the same direction has come in H J Muller's account (*Science*, July 1927) of his production of mutations in *Drosophila* by irradiating spermatozoa or oocytes with X rays When the correct dosage had been found, many mutations were produced, which on the whole were similar to those previously reported in *Drosophila*, such as 'white eye', 'miniature wing', and 'forked bristles' Most were recessive, but a number were dominant

One further point with regard to variations must be noted The possibilities of variation of an organism are strictly limited and circumscribed by the general physical and chemical properties of protoplasm The essential physiological processes, upon which the life and activity of organisms depend, are comparatively few Digestion, growth, sexual activity follow the same general lines throughout the whole animal kingdom It is probable that the physico chemical mechanisms alike of all muscular movement, of the movement of amœba by pseudopodia and of the movement of cilia, will fall into one general scheme Similarly, the transmission of the nervous impulse is being shown to proceed on essentially the same lines in animals of widely separated groups The essential physiological processes already function in the protista If the physiological processes are few and circumscribed, variations in structure and form will be limited also, recognising that form is "a product of an inner physiological activity" (Kusnetzov D'Arcy Thompson, "Growth and Form", 1917)

The last of the three principal factors on which Darwin based his theory of evolution was natural selection, or in Herbert Spencer's phrase, which Darwin adopted, "the Survival of the Fittest" Later, Ray Lankester suggested another formula, "the elimination of the unfit", which describes more correctly the meaning of the conception That natural selection, acting on heritable variations, is *a* factor in fixing adaptations is almost a

truism But whether it is the only factor, whether it is sufficient by itself to account for the living things we know, each fitting so perfectly its own little niche in its world, is a more difficult question The process is of necessity so slow But the time available is enormous, and geologists and physicists seem satisfied that it is to be reckoned in tens, if not in hundreds of millions of years We must consider also whether the mutations that occur are sufficiently diverse, for if adaptations are to be selected, mutations in the direction of those adaptations must occur The known mutations of *Drosophila* amount to some 400, but the mutations so far studied are, for practical reasons, those which are large and obvious There is increasing reason to think that they are outnumbered by small mutations which only long practice can detect Many mutations studied are slight colour changes, because they can be distinguished with remarkable precision by the practised human eye Correspondingly minute changes in size or shape would be very hard to detect, and to study them by breeding experiments and the methods of Mendelian analysis is not yet possible We can only form judgments about them by analogy with results from larger mutations There remains the statistical method of attack, by the study of mass populations of successive generations The method is efficient, active, and advancing, and it can only be lightly disregarded by those who have failed to grasp its meaning

Alternative or additional theories to account for evolution are favoured by many naturalists Darwin himself attached much importance to characters being inherited which had been produced by constant use or disuse in the parent This is a particular case of Lamarck's conception of "the inheritance of acquired characters", or, better expressed, of somatic modifications Some authorities consider that experimental proof of such inheritance is already available for example, MacBride cites the work of Kammerer and of Durkhen and Brecher, the latter work being supported also by Heslop Harrison On the other hand, Graham Kerr ("Evolution" London Macmillan and Co, 1926) advances strong arguments on the other side, and Goodrich ("Living Organisms", 1924) takes the same view "The real question Biology has to answer in future, as O Hertwig has pointed out, is not 'Are modifications inherited?' but 'How are new factors acquired?'"

Even if it could be proved experimentally, without possibility of question, that somatic modifications were inherited, we should only have advanced a little way towards an understanding of our problem The question *how* the soma influenced the factors in the germ cell would remain In this connexion Cunningham's suggestion that hormones provided a capable instrument is of interest, and might be followed up experimentally

The more elusive notions, which introduce the idea of some psychic or psychoid influence, controlling and regulating the processes of metabolism and organic growth, it is hard to distinguish from the animisms of primitive man, who finds a spirit on every mountain, a devil in every bush All these ideas contain a suggestion of purpose, some of them an idea of almost conscious purpose such as we know only in ourselves, or by analogy assume in higher animals, in each case associated with an elaborately differentiated nervous system They are brought into the story at the point where knowledge based on observation and experiment ceases, at the point where it seems to many of us more satisfactory to say frankly, I do not know

The idea of orthogenesis or nomogenesis (Berg, 1926), the idea that development takes place in a predetermined direction, is certainly unsatisfying in its elementary form An explanation of adaptations on these lines offers special difficulty, for the theory fails to provide the flexibility necessary to produce that constant adjustment of the organism to its ever changing environment which is imperatively demanded If, to reach the required adjustment, a predetermined direction of variations and of evolution is postulated in the organism, a predetermined evolution of the environment on parallel lines would surely be necessary That evolution proceeds according to laws of the same character as other laws of Nature, is the common basis of all modern evolutionary theory, and was held perhaps more strongly by Darwin, Huxley, and Weismann than it is by some writers of to day The physical laws in accordance with which the processes of growth are controlled, with results that we see in so many curious patterns, from the simple branching of a tree or of a nerve fibre to the elaborate spirals of a shell or of a growing plant, or again, the laws which lie behind the varied shapes, so curious and wonderful, of organisms and of their different parts,—these laws, and many others like them, still call for serious consideration and research This is the valuable feature of the theory of orthogenesis and in directing renewed attention to it, its followers make a valued contribution to biological thought

There are many other aspects of the problem of the origin of adaptations that might be considered, but it has seemed better to confine ourselves to the larger questions, even at the risk of saying nothing but what was already well known The outlook for biology to day is as alluring and as full of hope as it was in those years of joyful enthusiasm which followed the historic paper by Darwin and Wallace, communicated to the Linnean Society by Hooker in 1858 In whatever direction we look problems bristle, problems open to successful attack, and the old qualities, insight, patience, and determination, will get them solved But we must not limit the outlook, and all aspects of biological research must proceed hand in hand Botany, zoology, palæontology, the work of the systematist and of the field naturalist, the study of structure and the study of function, the work of the embryologist and of the experimental physiologist, of the geneticist and of the statistician, all are necessary, and none can succeed without the others

News and Views.

THE President of the Board of Trade has appointed a committee to report whether any, and if so what, amendments in the Patents and Designs Acts, or changes in the practice of the Patent Office, are desirable This committee may be regarded as the result of the suggestive report on the Reform of the British Patent System, issued by the British Science Guild in October last and reviewed in detail in NATURE of Nov 17, 1928 (vol 122, p 757) This report was the work of an expert committee of which Dr W H Eccles was chairman and Capt C W Hume, honorary secretary It immediately aroused the keenest interest throughout the country and even abroad, and was generally considered to be a very valuable document Nearly thirty professional institutions and organisations representing the industrial and business world appointed committees to consider the report, and a number of these are understood to have endorsed its findings in general terms, with reservations in matters of detail in some cases

AS no particular interest, to say the least, was taken in the British Science Guild report by the Board of Trade when it appeared, it is probably not too much to assume that the public attention since given to the report has now, after a lapse of seven months, led the President of the Board to appoint an official committee to consider the same subject The chairman is Sir Charles Sargant, a former Lord Justice of Appeal, and the members are Mr Horatio Ballantyne, a chartered patent agent and a director of Messrs Lever Brothers, Mr H A Gill, a chartered patent agent and member of several previous committees on patent matters, including the international conference of 1925 and the British Science Guild committee, Mr E H Hodgson, of the Board of Trade, Sir Herbert Jackson, Mr W S Jarratt, Comptroller General of the Patent Office, Mr Fearnley Owen, a solicitor, Mr J G Weir, a member of the Glasgow firm of engineers, and Mr James Whitehead, of the patent bar, who was chairman of the Dating of Patents Committee, 1927 The secretary is Mr R W Luce, a member of the non technical staff of the Patent Office We suggest that the absence of any representative of the electrical industry is to be regretted, since British industry is likely to be profoundly affected by electrical developments during the next decade, but perhaps the officials of the Board of Trade consider that the electrical aspects of the subject are sufficiently represented in the British Science Guild report

BY means of the Government grant of £100,000, and more than £180,000 collected by the *Times*, a very large sum is now available for the purchase of radium for Great Britain Prof F A Lindemann, in the *Daily Telegraph* of May 15, raised the question of justification for the present price of radium. The ordinary expectation is that when a chemical product is made the subject of large-scale operations, the price of the product will diminish With radium the reverse has happened, for when it was produced on a very small scale, the bromide of radium in a high state of purity could be sold, presumably at a profit, for about 32*s* per milligram of radium element content Large scale production was first attempted in America with the low grade ore carnotite, but the price was always a high one by comparison with that quoted above, and rose during the War to more than £30 per milligram of element Belgian production has brought the price down to £12, but the interests concerned have sold it for £10 per milligram where large quantities have been in question, and, on the other hand, they may charge £14, as stated by an official in a communiqué to the *Daily Telegraph* of May 25 Prof Lindemann's question remains a pertinent one, for whether it would pay to explore British territory for radium obviously depends on whether, with a find so rich as that in the Belgian Congo, production on a big scale would make a really big difference in the present selling price

THE retirement on May 20 of Mr W J Bean from the position of curator marks another milestone passed in the history of the Royal Botanic Gardens, Kew His loss to the establishment will be very great, for, in addition to his extensive knowledge of plants, he possessed considerable administrative ability and had the faculty of inspiring confidence and respect Mr Bean comes of Yorkshire stock and entered Kew as a student gardener in April 1883 His personality soon marked him out for advancement, and in 1888 he was given charge of the Temperate House Department His great opportunity came, however, in 1892, for in that year the late Sir William Thiselton Dyer began the reorganisation of the arboretum, and Mr Bean was transferred from the Temperate House to take charge of the work At that time the collections of trees and shrubs were weak in number of species, the general standard of cultivation was low, and really decorative subjects were not shown to advantage The work over a number of years was very arduous, but all who know the Kew arboretum of the present day will agree that Mr Bean is well repaid for his many years of hard work During the greater part of his career at Kew, Mr Bean has contributed to periodical horticultural literature He is also the author of "The History of the Royal Botanic Gardens, Kew" (Cassell, 1908), but is probably better known for his book "Trees and Shrubs Hardy in the British Isles" (John Murray, 1915), which has already been reprinted four times Mr Bean has for many years been a member of the Floral Committee of the Royal Horticultural Society, and the Society has awarded him the Veitch Memorial Medal and the Victoria Medal of Honour His services have on many occasions been requisitioned by public bodies at home and abroad, and in 1924 he was appointed a companion of the Imperial Service Order

THE Davy centenary celebrations at Penzance will take place on June 8, the arrangements having been made by the Royal Geological Society of Cornwall, the Royal Institution of Cornwall, and the Royal

Cornwall Polytechnic Society, the headquarters of which are respectively at Penzance Truro, and Falmouth At noon on that day the Mayor of Penzance, accompanied by members of the Town Council and of the three Cornish societies, will proceed to the Davy statue, upon which a wreath will be placed, luncheon will be served at the Pavilion at one o'clock, and at three o'clock a public meeting will be held in the same building, over which the Mayor will preside Addresses will be given by Dr J Symons, president of the Royal Geological Society of Cornwall, Mr J C Tregarthen, Sir Humphry Davy Rolleston, and Sir Ambrose Fleming, the last of whom will represent the Royal Institution of Great Britain, where for eleven years Davy worked and lectured so successfully An exhibition of Davy relics will be on view The Societies will be pleased to welcome anyone interested in the proceedings

THE seventh Annual Conference of the South Western Naturalists' Union was held at Torquay during Whitsuntide under the presidency of Dr F A Bather The Union covers the counties of Cornwall, Devon, Dorset, Somerset, Gloucestershire, and Wilts The meetings were held in the Pengelly Hall at the Museum of the Torquay Natural History Society, the president of which, Sir Francis Layland Barratt, received the guests The fine weather favoured excursions to Kent's Cavern, with Mr H G Dowie as guide, round Dartmoor, and to the chief points of geological interest in the neighbourhood of Torquay under the vigorous leadership of Mr G C Spence Sir John Russell delighted the members with an address on "The Conquest of the Waste Places", showing, chiefly by illustrations from the wheat belt of Canada and the irrigation of Australia and Egypt, how science has countered the pessimistic predictions of Sir William Crookes Mr F R Horne, of Seale Hayne Agricultural College, lectured on the succession of various woodland associations by grass land, and Mr J Walker read a paper on the moths and butterflies of the Torquay district The president's address, "Imagination and Fossils", showed how the controlled imagination can reconstruct the living form, habitat, and mode of life of vanished creatures quite unlike any now existing

ON May 15 a disastrous explosion, followed by fire, at the Cleveland Clinic, Ohio, was the cause of more than a hundred deaths among patients and staff The heavy mortality was due to gas poisoning, rescue work was much hampered by the dense brown choking fumes in the building, which, it was suggested, were bromine The first explosion appears to have occurred in the X ray department, and was probably due to the ignition of cellulose nitrate photographic film stored there In a statement made to Science Service, of Washington, D C, Dr Charles E Munroe, the chief explosives chemist of the U S Bureau of Mines, stated that, within less than a half minute after the explosion of such film, the resulting gases would be about one third carbon monoxide and one tenth oxides of nitrogen. These gases, produced in large quantities, spread through the building, and the brown fumes of the oxides of nitrogen were thought to be bromine The secondary explosion was probably due to the ignition of an explosive mixture of the carbon monoxide with air In investigations upon the effects of the fumes from smokeless powder explosions made by H C Knight and D C Walton at the Chemical Warfare Service's Edgewood Arsenal in 1925, it was found that experimental animals brought out of the explosion fumes, apparently unharmed, succumbed later to pulmonary œdema Since the fumes from smokeless powder are practically identical with those from cellulose nitrate film, this would account for the delayed poisoning effect shown by many of the victims

THE Linnean Society of London held its anniversary meeting at Burlington House on May 24, under the presidency of Sir Sidney F Harmer The following were elected officers of the Society for 1929–30 — *President* Sir Sidney F Harmer, *Treasurer* Mr H W Monckton *Zoological Secretary* Dr G P Bidder, *Botanical Secretary* Mr J Ramsbottom The Linnean Gold Medal for 1928–29 was handed to Dr J B Hubrecht, Counsellor of the Netherland Legation and son of the famous zoologist, for conveyance to Prof Hugo de Vries to whom the medal had been awarded in recognition of his great contributions to the advancement of botanical science In presenting the medal the president, Sir Sidney Harmer, paid tribute to the influence de Vries has had on biological thought since his thesis in 1870, particularly by his work on osmotic pressure, his theory of intracellular pangenesis, and his long series of studies on experimental evolution

LIEUT COL A T GAGE, having informed the Council of the Linnean Society of London that he wishes to resign his position as Librarian and Assistant Secretary at the end of October, Mr Spencer Savage has been appointed to succeed him Col Gage was formerly the Director of the Botanical Survey of India and Superintendent of the Royal Botanic Garden, Calcutta He entered the services of the Linnean Society as assistant to the late Dr B Daydon Jackson in 1924, succeeding him in office (though not with the special title of General Secretary) in 1926 Mr Savage has been clerk to the Society since 1911, with a break while on active War service He is well known to botanists by his bibliographical studies and to members of the Society as an authority on the Linnean collections and manuscripts

THE Hanbury Memorial Medal of the Pharmaceutical Society of Great Britain for "high excellence in the prosecution or promotion of original research in the Natural History and Chemistry of Drugs" has been awarded for the year 1929 to Prof Henry Hurd Rusby, professor of materia medica in the College of Pharmacy, Columbia University, New York The medal is purchased from a fund raised in 1876 to perpetuate the memory of Daniel Hanbury, F R S, who died in the previous year. His family name is perpetuated by the house of Allen and Hanbury, in which his father, Daniel Bell Hanbury, who survived him, was a partner His principal investigations were upon

the drugs of commerce of his time In 1927 the recipient of the medal was Dr T A Henry of the Wellcome Chemical Research Laboratories an authority upon the chemistry of the drugs and it is fitting that his successor to the award should be one who has specialised upon their botany and natural history So long ago as 1880 Prof Rusby accompanied an expedition organised by the Smithsonian Institution to New Mexico and Arizona where many new species of plants were discovered and in 1885 he was in Bolivia when some four thousand previously unknown species were found and described It was while exploring Para and Brazil that he discovered the plant *Cocillana* and first made known the medicinal properties for which it is now largely employed In addition to his explorations in Venezuela the rubber forests of the Madeira River and the forests of the lower Orinoco during the War he went on an expedition to Columbia in search of quinine yielding barks Nor did the passage of years blunt his zest for exploration for in 1922 he was in charge of the Mulford expedition which undertook a biological investigation of tracts of the Amazon basin In addition to the chair of materia medica he has the post of pharmacognosist to the Port of New York and with it the responsibility for the inspection of drug imports a task calling for ceaseless vigilance in the detection of ingenious adulterations He is at the moment engaged in a typically vigorous campaign to prevent the importation and use of decaying ergot from Russia Only twice before has the award gone to America—to J M Maisch in 1893 and to F B Power in 1913

AT the present time there is a great demand for underground cables suitable for carrying electric currents at very high voltages in towns and their neighbourhood A very large amount of experimental work in this direction has been carried out by cable manufacturers during recent years We learn from a paper by G Martinez which appears in the *Electrical Review* for May 24, that success is now almost assured by the invention of an oil filled cable In this cable there is inside the conductor a longitudinal duct carrying oil which is connected with reservoirs at the junctions at each end of a section When the conductors get hot the oil is forced by their thermal expansion into the reservoirs and when they get cool it is sucked back The conductor is insulated in the usual way, but owing to the diminished mechanical stresses on it the thickness of the insulation necessary is appreciably diminished The cable is armoured with hard brass strip over the lead sheath and is finally protected with waterproof cloth tape The working temperature of this oil filled cable can be much higher than that of the ordinary high voltage cable, and so it can carry a heavier load, while it can be safely laid directly in the ground There are no hollows inside these cables In ordinary cables the brush discharges that take place in a hollow are a frequent cause of breakdown It is claimed that it is possible to install underground cables of this new type up to pressures of 220 kilovolts We understand that two 132 kilovolt lines having a total length of 52 miles will be installed in London very shortly The installation is partly experimental but the makers have so much faith in the performance of their cables that they are taking the greater part of the financial risk

IT is expected that in a few weeks time the Brookmans Park Station the first high power station of the regional scheme of broadcasting in Great Britain will begin operation At first it will radiate only one programme but later on it is intended to radiate two simultaneously using different wave lengths It is probable that at first difficulties will be experienced by listeners especially those who are in the neighbourhood of Brookmans Park The foreign station listener in this district will have great difficulty in tuning out the local station The ordinary listener also may be unable to hear the programme from 5GB to which he has been accustomed The *Wireless World* for May 15 questions the wisdom of the policy of providing satisfactory crystal reception throughout Great Britain It suggests that this is probably being done at the expense of those who have invested in expensive valve sets These listeners have begun to think that they have a right to regard the continental stations as a source of entertainment however superior the quality of the home reception may be In the same paper there is an article on Getting ready for Brookmans Park describing methods of improving selectivity It is known theoretically that the selectivity of a receiving set can be improved either by diminishing the resistance of its tuned circuits or by increasing their number In the latter case a filtering effect is imposed on the incoming signals It is found in practice that the limit to which the resistance can be diminished is quickly reached We may increase the number of tuned circuits so as to filter out undesired signals but this would be expensive The most promising device is to use a tuned and variably coupled aerial transformer It is stated that in no other way can the selectivity of a set be so radically improved

EXTENSIONS of the building of the Royal Scottish Museum Edinburgh have permitted considerable expansion and rearrangement of the collections, while the Interim Report of the Royal Commission on National Museums by allaying the fear of fire permitted the progress of equipment and schemes previously held up Thus we read in the Director s type written Report for 1928 of the opening of a gallery of comparative ethnography, two new halls for natural history a civil engineering gallery and added exhibition space for minerals A beasts of prey hall and an architectural hall will be opened before long Still there are complaints of lack of space a printing press bought for exhibition has to be kept in store, while the consultation of reserve collections is hampered for want of storage accommodation. For all that, the collections grow the larger accessions include the Logan collection of British Lepidoptera, the late Robert Dunlop's fossils on loan from Dunfermline will be more accessible to students, a most useful collection of ceramics is lent by Lady Binning Among the numerous individual additions one notes the first specimen of the desert

wheatear to be found in the British Isles, the nest of a garganey duck—the first proof of its nesting in Scotland—and a self rescue apparatus presented by the Mine Safety Appliances Co of Pittsburg One learns without surprise that the museum grows in popularity Apart from the school classes and the lantern lectures to school children, the annual number of visitors has increased by 130,000 within the last eight years It is believed that visitors to the city are responsible for the numbers on week days, but that local people make up the large Sunday crowds Evening opening, so often clamoured for, appears here, as elsewhere, scarcely to warrant the additional cost of lighting and attendance

THE floating of globules of mercury on a water surface was described recently in letters to the Editor (Mar 16 and May 18) A correspondent reminds us that this effect was dealt with by Prof C V Boys in the second edition of his well known book on "Soap Bubbles and the Forces which Mould them" The description is as follows "One of the most beautiful bubbles of one liquid in another which can be produced is occasionally formed by accident If a basin of water containing a few pounds of mercury is placed under a violently running water tap the water and air carried down into the mercury cause mercury bubbles to form and float to the surface I have been able to float these into a second basin, where sometimes for a few seconds they look like shining balls of pure silver, perfect in form and polish When they break, a tiny globule of mercury alone remains, far more, however, than the liquid of a soap-bubble of the same size I have obtained mercury bubbles up to about ¾ inch in diameter M Melsens, who first described these in 1845, found the upper part to be so thin as to be transparent and of a slaty blue colour, a phenomenon which I have not noticed"

THE code devised at Strasbourg and adopted by international agreement for the telegraphic transmission of seismological information provides only for the data derived from the seismograms of individual stations (NATURE, Dec 22, 1928, p 968) There are occasions, however, when the sender of a report has already determined the epicentre of an earthquake and wishes to give its position For this purpose, a simple method has been adopted by the Meteorological Office and by the U S Coast and Geodetic Survey At the close of the report there will be added the word 'epicentre' and a group of five figures The first two figures give the latitude and the last three the longitude If the latitude is north and the longitude east, the number 2 is added to the middle figure, if south and east the number 4, if south and west the number 6, and if north and west the number 8 Thus, the figures 01779 would indicate that the epicentre is in lat 1° S, long 179° W

IN the January issue of the *Bulletin de la Société d'Encouragement pour l'Industrie nationale*, the Agricultural Committee of the society gives an account of the steps which have been taken during the past twenty years by the railway companies of France to encourage agriculture and the remarkable results obtained. The Paris Orleans company in 1903 began to distribute pamphlets, to organise lectures, discussions, and demonstrations, with the view of improving and intensifying production and increasing the possible markets for fruit, cereals, potatoes wines, cattle, milk, butter, cheese fowls, eggs, and honey Special officials were appointed to deal with the rapid transport of this produce to market The result of these efforts was remarkable in 1905 the company carried 250,000 tons of agricultural produce, and in 1907, 639,000 tons Other French lines have taken similar action with like noteworthy results

DR J H QUASTEL of Trinity College Cambridge, who is known for his work on reduction oxidation systems and for his studies of the activation of molecules by living organisms, has been appointed biochemist at the Cardiff City Mental Hospital

A VIOLENT earthquake was recorded at Kew Observatory commencing at 22 hr 51 min 19 sec G M T, on May 26 The epicentre is estimated to have been 4800 miles away but the initial impulse was not sharp enough to give any indication of the bearing

AT the annual general meeting of the Institute of Physics held on May 28, the following were elected to take office on Oct 1 next —*President* Dr W H Eccles *Honorary Treasurer* Major C E S Phillips, *Honorary Secretary* Prof A O Rankine Sir Ambrose Fleming, Sir James Jeans, and Sir Oliver Lodge were elected honorary fellows of the Institute

IT is announced in *Science* that the Agassiz medal for oceanography of the National Academy of Sciences of the United States has been awarded to Prof J Stanley Gardiner, professor of zoology and comparative anatomy in the University of Cambridge, and the Watson medal to Dr Willem de Sitter, director of the Observatory at Leyden and professor of theoretical astronomy in the University

THE fourteenth Annual Conference of the Museums Association will be held at Worthing on July 1-5, under the presidency of Sir Henry Miers The presidential address, on "Co-operation—the Association's Task", will be delivered on July 2, and will be open to discussion In connexion with the Conference there will be an exhibition of museum furniture and requirements The local secretary for the meeting is Miss Marian Frost, The Museum, Worthing

THE Rochdale Literary and Scientific Society has celebrated the jubilee of its formation by the publication of a volume of *Transactions* covering the years 1926-28, and by the presentation of his portrait to Dr J R Ashworth, in recognition of his services as honorary secretary since 1885 Dr Ashworth contributes a short article on "The Influence of Rain on Atmospheric Deposits", and an unusual and well-illustrated account of the very varied structure of the old pack horse tracks about Rochdale is given by Jas L Maxim

THE Council of the Association of British Chemical Manufacturers has decided to prepare and issue to its members a set of model safety rules for use in chemical

works The Works Technical Committee has been actively engaged for some months on the preparation of these rules, and a small booklet of provisional rules has now been presented to members of the Association A set of explanations of these rules is in preparation by the Association, the address of which is 166 Piccadilly, London, W 1

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —A lecturer in the Electrical Engineering Department of the Sunderland Technical College—The Chief Education Officer, 15 John Street, Sunderland (June 5) Assistant Examiners in the Patent Office—The Secretary, Civil Service Commission, Burlington Gardens, W 1 (June 6) A principal engineering inspector under the Engineering Inspectorate of the Electricity Commission—The Secretary, Electricity Commission, Savoy Court, Strand, W C 2 (June 8) Lecturers in, respectively, engineering, chemistry, and physics, and a mechanical workshop instructor and an electrical instructor, each at the Constantine Technical College, Middlesbrough—The Director of Education, Education Offices, Middlesbrough (June 10) An assistant lecturer in Nature study and horticulture at Stranmills Training College, Belfast—The Principal, Stranmills Training College, Queen's University, Belfast (June 10) A principal of the Government Commercial Institute, Calcutta—The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, S W 1 (June 12) An assistant lecturer in the Mathematical Department of the Derby Technical College—The Secretary, Education Committee, Becket Street, Derby (June 14) A director for the Harcourt Butler Institute of Public Health, Rangoon—The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, S W 1 (June 15) A scientific assistant under the Imperial Bureau of Soil Science—The Director, Imperial Bureau of Soil Science, Rothamsted Experimental Station, Harpenden (June 19) An assistant lecturer in mathematics in the University of Sheffield—The Registrar, The University, Sheffield (June 19) A bacteriologist at the Antitoxin Establishment of the Metropolitan Asylums Board, Sutton—The Clerk, Metropolitan Asylums Board, Victoria Embankment, E C 4 (June 19) A senior plant introduction officer, an assistant plant introduction officer, an assistant plant pathologist, a weeds officer, an assistant mycologist, an assistant plant geneticist, and two assistant agrostologists under the Commonwealth of Australia Council for Scientific and Industrial Research —F L McDougal, Australia House, Strand, W C 2 (June 20) An assistant Government analyst, Hong Kong—The Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, Whitehall, S W 1 (June 30) A research assistant in dyeing in the University of Leeds—The Registrar, The University, Leeds (July 1) A zoologist on the scientific staff of the *Discovery* Committee—The Secretary, *Discovery* Committee, Colonial Office, S W 1 (July 15) A senior secretary on the central administrative staff of London University—The Principal, University of London, South Kensington, S W 7 A lecturer in library routine and practical cataloguing in the School of Librarianship, London University—The Secretary, University College, Gower Street, W C 1 A laboratory steward in the physics department of the University College of Hull—The Secretary, University College, Hull

Our Astronomical Column.

THE TOTAL SOLAR ECLIPSE OF MAY 9 —*Harvard Announcement Card*, No 87, announces that Prof H T Stetson, who was stationed at Alor Star, Kedah, experienced some interference from high cirrus clouds, but succeeded in measuring the illumination of the corona. He found it equal to 0 15 candle at 1 foot, or to 1 candle at 2 58 feet As the brightness of the sun has been given as equal to 5000 candles at 1 foot, it is about 33,000 times as bright as the corona

A DOUBLE STAR OF THE TYPE OF GAMMA VIRGINIS —Mr C Luplau Janssen discusses the orbit of the star Burnham 12304 in *Mon Not. Roy Ast Soc* for March He shows that the distance, which increased from the discovery of the duplicity in 1832 up to 1910, is now decreasing, and that an approximate orbit can now be deduced That which he gives is of the type of Gamma Virginis with very large eccentricity (0 95) and very close approach at periastron, which he calculates will take place in 1976 The period is 177 2 years, and the semi major axis 2 81″ The hypothetical parallax is 0·089″ It is important to follow the star carefully during the approach to periastron.

HISTORICAL RECORDS OF METEORIC SHOWERS —Prof W J Fisher, of Harvard College Observatory, Cambridge, Mass., has issued a circular, and distributed it amongst astronomical and other scientific institutions, asking for old accounts of abundant meteoric displays He intimates that though many descriptions were found by Newton, Quetelet, Herrick, and others, there must be numbers of additional records which have never yet been brought into the light and suitably investigated That this may be accomplished, and that a thorough discussion of all the available results, ancient and modern, may be submitted to examination and deductions made, seem desirable It is therefore hoped that persons having access to ancient works containing accounts of long past meteoric exhibitions will search them out and send copies of them to the Harvard Observatory so that they may receive due consideration.

With new data gleaned from old catalogues and chronicles, and the whole comprehensively treated, there is no doubt that our knowledge might receive important additions of interesting kind From Russian and Japanese sources some useful details have already been received, and the research promises good results if the subject is amply worked up and supported as it undoubtedly deserves.

Of the display of Leonids in November 1766 nothing is apparently known more than mere rumours can convey Dr Dick says the meteors of 1799 were seen by all the inhabitants of Cumana, the oldest of whom asserted that the great earthquakes of 1766 were preceded by similar phenomena. Further careful inquiry might elicit important details.

Research Items

Food of the Great Horned Owl.—A short account of the more striking habits of this owl (*Bubo virginianus*) appears in the *Canadian Field Naturalist* for April. In the poplar savanna of Manitoba where the author, Ralph D. Bird, studied the owl, he estimated that one nesting pair was present in every square mile of suitably wooded country, the presence of good hunting grounds being apparently a decisive factor in the selection of the site. The birds when disturbed have been known to attack man, and the author describes a concerted attack upon himself which had serious enough consequences. An examination of 112 food pellets showed that as a staple diet rabbits headed the list, then followed voles, pocket gophers, ground squirrels, and occasional birds taken especially after the spring migration. The association of prairie and woodland mammals in the diet suggests a wide hunting range on the part of the owl. Although the nests were not far from farmyards, only one domestic fowl was found to have been taken, and game birds did not average as many as two per nest. The conclusion is that the bird is a decided benefactor to humanity, through its enormous destruction of rodents, which injure crops and are second only to fire as a factor in checking the spread of the forests.

The Genus Phellia.—Dr. T. A. Stephenson's account (*Trans. R. Soc. Edin.*, vol. 56, 1929) of the British species of *Phellia* fills a lacuna in our knowledge of British sea anemones. In 1858 P. H. Gosse collected from a 'rock called Proudfoot at the entrance to Wick Bay in Caithness', the original specimens of *Phellia gausapata*. The author visited this rock in 1926, and collected thirteen examples of the species, and has given an account of their external characters and internal anatomy. He has examined three other species which have been regarded as belonging to the genus *Phellia*, and shows that two of them—*P. murocincta* and *P. picta*—are Sagartias, and that the other—*P. brodricii*—should be placed in a new genus, *Cataphellia*. The genus *Phellia* is defined for the first time on a valid basis and its relationships determined; it is removed from the Sagartiidæ and placed in a separate family, the Phelliidæ—with *P. gausapata* as the type species. The patterns developed on the disc and tentacles in the Phellias and other sea anemones are analysed, and their value as an indication of relationship discussed, especially in respect of species the relationships of which are difficult to determine. The paper is illustrated by text figures and by finely executed drawings in colour which have been admirably reproduced.

Genetics of Primula Kewensis.—In 1899, *Primula Kewensis* appeared at Kew as a natural hybrid between *P. floribunda* and *P. verticillata*. The cross was then successfully made, but has never been repeated, the few plants obtained in later attempts being either like the mother (*floribunda*) or tetraploid *Kewensis*. The original diploid hybrid plants first bore seeds in 1905, producing the tetraploid form. Owing to errors in the early work on this form, it has long been a cytological and genetical misfit. In a paper by the late W. C. F. Newton and Miss C. Pellew (*Jour. of Genetics*, vol. 20, No. 3), which will become a classic, the various problems regarding its origin and genetical nature are solved, and it is brought into line with other cases in recent genetical literature. The fertile *P. Kewensis* is shown to be a tetraploid mutation arising in somatic tissue of the sterile diploid hybrid, and not due to a transverse fragmentation of the chromosomes as formerly supposed. Usually the diploid hybrid is highly sterile, but on the three occasions in which it is known to have set seeds, these gave rise to fertile tetraploid plants. The third lot of such plants grown at Merton was the largest, numbering 287 plants, of which 261 were of the ordinary tetraploid type, while the remaining 26 showed much variation, which was generally associated with the presence of 35 or 37 instead of 36 chromosomes. There is also variation in mealiness and shape of the leaves. Several other cases are now known in which a tetraploid form is produced in the crossing of two diploid species, but *P. Kewensis* differs from these in that the tetraploid condition first arises in somatic tissues. By crossing it with the diploid parents, various triploid or near-triploid forms have been obtained and studied. This paper is an excellent example of the necessity for cytological studies in the investigation of any complicated genetical situation, but various problems regarding the descendants of *P. Kewensis* remain to be attacked.

Sodium Accumulation and the Earth's Age.—In the *Am. Jour. Sci.* for April 1929, Prof. A. C. Lane directs attention to yet another source of error in this much discussed method of estimating geological time. It has been customary in estimating solvent denudation to take several analyses of the river water and average them to get the average composition, and then multiply this by the total run-off. This neglects the fact that generally speaking the greater part of the run-off of a river is in floods, and that in time of flood the amount of sediment is greater and of dissolved matter much less than when the river is normal or low. From work by W. D. Collins on the Colorado River and by L. Nys on the Meuse and the Ourthe, Lane deduces that it would not be safe to take the solvent denudation of the lands by river waters at more than five-eighths of that usually adopted (for example, by F. W. Clarke in his well-known "Data of Geochemistry"), and he thinks there is a fair possibility that it may be no more than two-fifths. Making allowance for other factors and for the slow denudation of small continents in times of peneplanation and marine transgression, it is not difficult to bring the figures for the age of the earth by solvent denudation into agreement with the longer periods obtained from the lead ratios of radioactive minerals.

Limestones and Limestone Soils of the East Indian Archipelago.—In *Communication* No. 14 of the Geological Institute of the Agricultural University of Wageningen, Holland, Prof. J. van Baren has presented in English the results of his investigations during the last thirteen years on the weathering of limestones and the formation of limestone soils in Java and other islands of the Dutch East Indies. Detailed qualitative mineralogical analyses are given for 21 rocks and for two mechanical fractions of 46 soils derived from them. Other soil data include colour by Lovibond's tintometer, mechanical analysis, hygroscopic coefficient, maximum water capacity, and reaction measurements by several methods. Full chemical analyses are given for a dozen soils and their underlying rocks. It is concluded that the properties of the soils are determined primarily by the composition of the limestone rock. Although the rainfall is important, the present knowledge of agricultural climatology is totally inadequate as a basis for the classification of soils and soil-forming processes. The analogies that have been drawn between the red limestone soils of the tropics and other red soils,

such as the Mediterranean *terra rossa* are strongly criticised The red colour shows nothing beyond the presence of some colloidal iron oxide of unknown origin and gives no evidence that the soil has been formed in a humid tropical climate It is claimed that the careful collection of facts must proceed for many decades before generalisations on the relation of soil to climate can have any value Prof van Baren appeals especially for detailed and systematic mineralogical research on the relation of the soil to the parent rock He has been able to distinguish minerals formed within the soil from those derived from the parent rock or introduced by the action of volcanoes water or wind The fuller study of such newly formed minerals should reveal some of the chemical processes within the soil Again it is shown that apatite is rarely present in either soils or rocks and cannot be the source of the phosphoric acid in these soils Prof van Baren s detailed notes photomicrographs and bibliographies on the minerals and organic remains identified will prove of great value in extending this type of work

REFRIGERATION CONSTANTS —Supplement No 65 to *Communications* from the Physical Laboratory of the University of Leyden contains reprints of the papers communicated by Drs Keesom and De Haas to the Institut International du Froid on the entropy temperature and total heat entropy diagrams of methane ethylene, nitrogen hydrogen and helium The whole of the experimental facts available have been used in constructing the diagrams and have been supplemented where necessary by thermodynamic relations and the law of corresponding states Copies of these diagrams may be obtained by those interested in refrigeration through the Institut International du Froid

DIFFRACTION OF LIGHT —The April number of the *Physical Review* contains a paper by Profs M E Hufford and H T Davis which is illustrated by a very beautiful pair of photographs of diffraction patterns These were produced by passing mono chromatic light from a small source through two circular holes and the one from the smaller aperture shows some seventy clear concentric rings in the original The radii of these have been measured up carefully and have been compared with the radii computed by an extension of the classical wave theory of diffraction by a circular aperture which was given by Lommel calculated and observed values are in good agreement As the authors point out an investigation of this nature would have been considered to be of purely academic interest a few years ago whereas at the present time it is of con siderable value in defining the regions in which wave theory and quantum theory are individually appli cable It is to be regretted that the detail of the photographs, exceptionally good as it is is insufficient to show the presence of some secondary fringes that should theoretically be present

BRIDGE STRESSES —The issue of the *Journal of the Royal Society of Arts* for May 3 contains the Trueman Wood lecture delivered by Sir J Alfred Ewing on the results of the work done during the past six years by the Bridge Stress Committee of the Depart ment of Scientific and Industrial Research It has been found that the passage of a locomotive over a bridge produces a deflection at the centre which oscillates between limits determined by the weight of the locomotive and the intensity of the hammer blow it strikes on the rails due to the movement of unbalanced parts of its mechanism Some of the lighter engines still in use weighing 15 tons per axle deliver a blow equivalent to a further 15 tons, when some of the more modern ones weighing 20 tons per axle only deliver a blow equivalent to a further 5 tons The subject is too complex to allow simple rules for the calculation of the stresses produced to be formu lated

ARTIFICIAL VERSUS NATURAL ILLUMINATION —In a paper on the cost of lighting industrial buildings which appears in the *Journal of the Franklin Institute* for February L L Holladay discusses some of the problems which arise when the electric light can be purchased at a price not exceeding about 0 7 of a penny In several cases he proves that artificial light is more desirable than daylight from the eco nomical point of view It is pointed out that natural light whilst costing nothing out of doors can only be delivered at a certain definite cost indoors The cost and maintenance of the windows and the lighting shafts has to be taken into account In the winter time the thermal losses through the windows are appreciable and increase the heating costs In making the comparison between the running and overhead costs of a building built for artificial lighting and one built for utilising the daylight also when possible it is assumed that both buildings have similar ventilat ing and heating apparatus It is assumed that for seven months of the year the inside of the building is maintained at 65° F and that the air is completely changed twice every hour The costs of washing the windows at least twice every year and cleaning the lamps at least six times are taken into account The heat loss due to the windows is generally offset by the saving they effect on the cost of the electric light The author recommends therefore, that industrial buildings should be built with simple side windows A windowless building requires a shaft about two feet wide for ventilation It is not economical to incur heavy expenses for lighting shafts or windows in the roof For dwelling houses we must have windows to enable us to see outside but in factories the glass of the windows is often obscured The conclusion is that when artificial illumination can be obtained very cheaply it would be well for the architect to take this into account when designing the building

THE TESTING OF PORCELAIN INSULATORS —The initial and maintenance costs of the large number of porcelain insulators required for high tension overhead distributing systems have made it necessary to apply rigorous tests to them before they leave the factory They are usually tested in accordance with the standard specification or with one which follows it very closely in essential details Specifications based on the individual opinions of consulting engineers are now very rare In a paper read to the Institution of Electrical Engineers on April 11, B L Goodlet dis cussed the technique of porcelain insulator testing The three basic electrical tests are the dry and the wet spark over voltage and the puncture voltage The fundamental mechanical and physical tests are for mechanical strength, ability to withstand a tempera ture cycle, and the test for porosity In addition, seven other tests, including corona tests, fog tests, and tests to determine 'fatigue under vibration, are sometimes specified The six fundamental tests are generally considered to be sufficient If the physical laws which govern the effects produced were better known it is highly probable that the required tests could be much simplified and appreciable economies effected The influence of the atmospheric humidity on the spark over tests is known to few physicists. Curiously enough, an increase in the humidity of the atmosphere up to about 75 per cent, at 40° C, in creases the voltage at which a flash occurs The wet

spark over voltage test is made with artificial rain As the rate of precipitation is increased the spark over voltage falls rapidly until a rainfall of about 3 mm per minute is reached after which a further increase in the intensity of the rainfall has little effect on the voltage at which spark over occurs The angle of the rainfall has a considerable effect on the result and so also has the resistivity of the rain which is a very variable quantity It is found that fog troubles only occur in districts where a considerable amount of solid matter in a finely divided state is suspended in the atmosphere

RADIO RECEPTION IN A TUNNEL —Some interesting experiments were recently made by Dr A S Eve of McGill University, and several well known radio engineers on reception in a tunnel on the Canadian Pacific Railway The results are printed in the *Proceedings of the Institute of Radio Engineers* for February The tunnel is $3\frac{1}{2}$ miles long and passes through Mount Royal near Montreal Preliminary experiments made in 1926 indicated that the penetration of radio waves into the tunnel was a function of their frequency If the wave length was less than 100 metres the radio waves died away within a few hundred feet of the mouth of the tunnel More exact experiments made in 1928 bring out the fact that the wires cables and rails leading into the tunnel play an important part in the reception by the receiving set The mouths of the tunnel were blocked and the cables were earthed The results showed that the effect of the cables and rails was also a function of the frequency The experiments show that more energy enters through the tunnel mouth than was at first suspected The effects of the rails and cables were due to a variety of causes which involve wave antenna effects and re radiation Curves are given showing graphically the results obtained and details are given of the geology of the region Amongst the conclusions arrived at are that short waves do not penetrate rock or soil to any appreciable extent that cables and rails conduct long waves better than short waves that insulated wires and cables act as wave antennæ and that a very appreciable amount of energy enters through the tunnel mouth Further work is required in a tunnel with no wires or rails leading into it

PULVERISED FUEL IN POWER STATIONS —In a paper read to the Institution of Electrical Engineers on April 18, Mr R A Chattock discussed the use of pulverised fuel in electric power stations He claims that as the result of the experimental work carried out during the last few years at the Birmingham electrical power station, it has been proved that the use of pulverised fuel gives a higher combustion heat efficiency in the boilers than is obtained by mechanical stokers He points out that for pulverised fuel equipment the capital cost is greater than for mechanical stokers, but, as boilers can be used of far greater capacity than those equipped at present with mechanical stokers, there is a considerable economy effected in the cost of boilers and boiler house In the second series of tests made at Birmingham, the equipment consisted of four large coal driers of the rotary type which were fired by small furnaces These driers reduce the total moisture in the coal from 20 per cent to 6 per cent without driving off any material part of the volatiles contained in the coal The dry coal was conveyed by elevators and conveyors to bunkers in the boiler house From thence it was fed to four large motor driven mills each capable of pulverising 12 tons per hour The mills are air swept and the fuel is caught in cyclone collectors and stored in bins over the boiler From these bins it is delivered by special feeders to the six burners installed in each boiler furnace Two of these boilers have been in operation for a year with a combustion heat efficiency of about 85 per cent These experiments have led the Birmingham Corporation to adopt boiler units having an evaporative efficiency of 200 000 lb of water per hour for the new Hams Hall Station Unit pulverisers will be used for the boilers each of which will have five mills four to run and one to be kept in reserve New developments are in progress but satisfactory results extending over several years have been obtained both in America and on the Continent

PREPARATION OF SUBSTITUTED DIPHENYLAMINES —The preparation of substituted diphenylamines is often a matter of some difficulty and it is therefore interesting to note that a new method is given by A W Chapman in the *Journal of the Chemical Society* for March As previously shown *N* arylarylimino aryl ethers [R C (OR″) NR] are converted quantitatively by the action of heat into acyl derivatives of the corresponding diphenylamines [R CO NR R″] and on treatment with alcoholic potash these acyl compounds are readily hydrolysed to the corresponding diphenyl amines in yields of about 80 per cent

SOLUBILITY OF IODINE IN SOLUTIONS OF HALIDES — The *Journal of the Chemical Society* for March contains an account of experiments carried out by Carter and Hoskins which appear to show that the solubility of iodine in solutions of halides is the result of a tendency to form polyhalides and the opposing salting out effect The latter effect is considerable with bromides and chlorides but negligible with iodides and with the halogen acids Attention is directed to the fact that in their investigation of the tri iodide equilibrium Brönsted and Pedersen used potassium chloride solution as solvent and assumed that all the dissolved iodine was present in the free state No allowance was made for the effect of polyhalide formation and hence the mass law expression deduced by Bronsted and Pedersen is incorrect The corrected value for the equilibrium constant in this case is approximately the same as when the solvent is water

BENZENE RING —The April number of the *Proceedings of the Royal Society* contains a full account of Dr Kathleen Lonsdale s investigation of the crystal structure of hexamethylbenzone $C_6(CH_3)_6$ which as was indicated in a letter from her to NATURE on the same subject (Nov 24 1928 p 810) is of great interest from the way in which it confirms current ideas of the structure of the benzene ring This particular molecule, unlike many other aromatic compounds, exists as a separate entity in the crystal, which is triclinic and easily deformed The X ray evidence is definite that the molecule is in the form of a ring and that its nucleus is similar both in size and shape to the six carbon ring of graphite The X ray measurements also show that the carbon atom of the methyl group lies in the plane of the benzene ring so that at least three of the valencies of the aromatic carbon atom must be coplanar There is unfortunately no new information to be had concerning the elusive fourth bond except that it must be disposed so as to give the ring as a whole a centre of symmetry, which seems to rule out Kekulé s static model with its three double bonds The carbon atoms in the methyl groups, as would be expected from their aliphatic nature, resemble the carbon atoms in diamond rather than those in graphite, the methyl group itself, to use Dr Lonsdale's analogy, acts towards X rays very like an electron shuttlecock, if we picture a single atom as a tennis ball

In the Yellowstone with Princeton [1]

By Prof O T JONES, University of Manchester

IN the issue of NATURE of Nov 5, 1927, Mr E B Bailey gave a brief account of the 'Summer School of Geology and Natural Resources', which has been organised by Prof R M Field, of the University of Princeton, N J I was privileged last summer to be the guest of the Summer School in a tour through some of the characteristic regions of the United States, my fellow guests being Mr W J Johnston, of the Canadian Geological Survey and Prof W A Parks, of Toronto

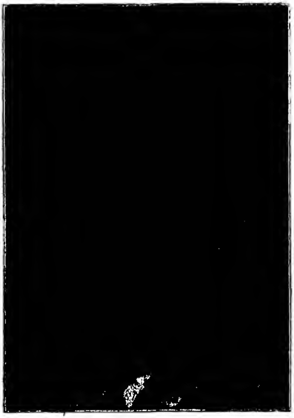

FIG 1 —Section of lower part of sediments near Red Rock Photograph by Prof O T Jones.

We started from Princeton on June 21, and returned on Aug 2, and in the course of the tour we visited the Yellowstone National Park

Within its area of 3344 square miles, this Park numbers many remarkable features, and among them the great canyon which has been carved by the Yellowstone River on its way to join the Missouri is one of the most interesting After leaving Yellowstone Lake the river winds through a flat floored valley before plunging in succession over the Upper Fall (108 ft) and the Lower Fall (309 ft), where the canyon commences About 20 miles lower down, the Yellowstone is joined by the Lamar, an important tributary flowing in a wide, flat floored valley

In the course of the 1926 excursion, Prof Field observed from near Artist's Point some sediments in the opposite wall of the canyon about half a mile below the Great Fall, and with a kinematograph camera and telephoto lens obtained a clear record of these deposits In August 1928 we visited the locality and examined the sections in detail Our examination led to the discoveries in regard to the remarkable history of the canyon which are briefly summarised below [2]

The sediments which Prof Field had previously observed lie in a narrow 'in and out' channel which passes behind a prominent pinnacle on the canyon wall known as the Red Rock, and consist of more than 187 feet of alternations of blue muddy silt, yellow sand, and conglomerate, the coarser deposits having a calcareous or tufaceous cement (Fig 1) The base of the channel lies about half way down the canyon wall, which at this point is about 800 feet high Dr Elwyn Perry and other members of the Summer School observed also a small thickness of sediments within 50 ft of the bottom of the canyon and within about 100 yards from the foot of the Great Fall, and one of us noticed on the west side of the canyon, where it is drenched by the spray of the fall, a patch of blue stratified material which appeared to be similar to the silt near the Red Rock On our return to the east we discovered that this exposure had been visited nearly sixty years ago by Dr A C Peale, during the preliminary survey of the Park by F V Hayden and his assistants Dr Peale described this material as a blue mud, and there is little doubt that this and the sediments low down on the opposite side of the canyon are relics of the same series as that more fully preserved near the Red Rock We found, too, that the east wall of the canyon, between the Upper and the Lower Fall, is composed in large part of cross bedded sands capped by a tough conglomerate with tufaceous cement

According to the prevalent opinion, the canyon was eroded in postglacial times, and it has been regarded as evidence of the enormous amount of denudation that has taken place since the Glacial Epoch Colour was lent to this view by the distribution of the terraces which surround the Yellowstone Lake and extend down into the Hayden Valley towards the Yellowstone Falls These terraces are composed in part of resorted glacial deposits which occur around the Yellowstone Lake and in the Hayden Valley, and are therefore clearly of postglacial date It appears also that the conglomerate between the Upper and Lower Falls has been interpreted as an extension of these terrace deposits, and it was so regarded by E De Martonne, who figured the section in the *Annales de Geographie* (vol 22, 1913, Pl II B, facing p 136). This was also the interpretation adopted by Mr W H Holmes in his report on the geology of the Park attached to Hayden's 12th Annual Report on the Territories, 1878 As this conglomerate occurs on both sides of the present canyon, it was argued that the canyon must be of later date than the Yellowstone Lake terraces, and therefore postglacial Our examination disclosed, however, that a pre existing canyon had been at some period filled to the brim with sediments, and the relation of these to the glacial deposits seemed to indicate that not only the erosion of the canyon but also its subsequent filling had taken place before the advent of the glacial period, and that the canyon was a much older feature than had been previously supposed.

The fine muddy silts which form a considerable proportion of the sedimentary succession in the canyon recall lake deposits, and the occurrence of several

[1] Based on a lecture entitled "The History of the Yellowstone Cañon (Yellowstone National Park), U S A delivered before the Geological Society of London on Jan 9

[2] A more detailed account appears in the *Amer Jour of Science*, March 1929

layers of silt following immediately upon conglomerate inevitably suggests the establishment of lakes in the canyon at successively higher levels, and their subsequent filling with deposits beginning with fine sediments and ending up with coarse sands and gravels. Such lakes could only come into existence if the canyon had been dammed below this point subsequent to its erosion. What then was the agent which impounded these lakes in the canyon? The study of the geological maps in the United States Folio (1896) suggested the possibility that great flows of lava had entered the Yellowstone Valley from the north from the direction of Gardiner, and had flowed against the direction of the drainage into the Lamar Valley and the canyon. On the geological map of the Canyon and Gallatin Sheets several small masses of basalt and trachytic rhyolites have been mapped the relation of which to the flanks of the valley suggests that they are relics of flows which must originally have been of wide extent and filled the lower Yellowstone Valley to a depth of more than 1500 ft.

The suggestion that arises naturally from the study of the geological map is, however, contrary to the interpretation of certain of these flows which is embodied in the description of the Folio which was published in 1896. The summary in the Folio of the geological and volcanic history of the region is due to Arnold Hague. The igneous rocks were described by Iddings in Monograph 32, Part II, and in this monograph reference is made to the account of the physiography of the Park by Hague in Monograph 32, Part I. It appears, however, that this part of the monograph has never been published, and we are dependent upon the brief summary of the geology of the Park which accompanies the folio.

Hague's view of the volcanic history of the Park is embodied in the following table:

Pleistocene	Glacial drifts, etc.
Neocene	Basalt
	Rhyolite
	Basalt
	Canyon Conglomerate
	Basalt
	Andesitic flows and breccias
	Trachytic rhyolites
	Basic breccias
Eocene	Acid breccias
	Pinyon Conglomerate
	Unconformity
Cretaceous	Laramie formation

Fig. 2.—Section near Tower Falls showing two basalts with intervening conglomerate resting on andesitic breccias. Photograph by Dr. M. B. Hodge.

The rocks to which special attention is directed are the trachytic rhyolite which was assigned to a period during the accumulation of the Neocene volcanic breccias and the two basalt flows with the intervening canyon conglomerate which were believed to underlie the rhyolite. Since the canyon conglomerate yielded fragments of bones which were identified by Prof. O. C. Marsh as belonging to the skeleton of a fossil horse of Pliocene time the rhyolites must, according to this view, have been erupted at a late stage in the Pliocene period and the erosion of the canyon through the rhyolites must have occurred at a still later period. As this interpretation of the relation of the basalts, canyon conglomerate and trachytic rhyolite to the main rhyolite seemed to be at variance with the distribution of these rocks as shown on the geological map, Prof. Field and I decided to investigate this problem further.

Fig. 3.—Drawing of section near Tower Falls by W. H. Holmes. From Hayden's 12th Annual Report of the Territories, 1878.

In various places on the route between Gardiner and Camp Roosevelt, which lies near the junction of the Yellowstone and Lamar Valleys, there are masses of

basalt and trachytic rhyolite which are obviously perched on narrow shelves on the valley sides and their situation is such that these lavas must have been poured out on to the floor of a pre existing valley

The most convincing evidence of the relation of the basalts to other rocks in the canyon is, however, obtained near the Tower Falls south of Camp Roosevelt, where Tower Creek drops into the Yellowstone Above Tower Falls the 'canyon' is a fairly wide valley with terraced slopes Near Tower Falls the river swerves to the west and enters a very narrow canyon with almost precipitous walls of andesitic breccia which has been eroded into a striking series of pinnacles or 'needles' This is the 'second canyon' of earlier observers, and is probably of postglacial origin Its rim is formed by a sheet of basalt with remarkably regular columnar jointing, this sheet is easily accessible on the road on the west side, where it rests on a conglomerate On the east side the basalt overlies a conglomerate about 100 feet thick, underneath which is another band of columnar basalt (Fig 2) This striking section is among those drawn by W H Holmes, and a comparison of recent photographs with the sketch made more than fifty years ago demonstrates the remarkable accuracy of that artist (Fig 3)

If the east side of the second canyon be examined for about a mile below Tower Falls the upper basalt can be traced as a continuous band, but the lower basalt is only present at the north end and the south end, and is not visible in the intervening space, where also the conglomerate is reduced to about one quarter of its thickness (Fig 4) This behaviour of the lower basalt and the conglomerate as seen from the west side of the canyon is due to the fact that the lower basalt and the lower part of the conglomerate pass behind a screen of the andesitic breccias which form the lower wall of the canyon In other words, the basalt and conglomerate series occupy an old valley, and the existing canyon has been eroded on the flank of that valley through the basalts and conglomerate into the underlying andesitic breccia On the roadside south of Tower Falls the flank of the old valley stands at a still higher level, so that only a few feet of conglomerate separate the upper basalt from the andesitic breccias, ultimately it cuts out from below the upper part of the conglomerate, and the upper basalt then comes to rest on the andesitic breccias that formed the flank of the old valley There is here convincing evidence that the basalts and conglomerate have filled in a valley which formerly continued in the line of the wide part of the canyon above Tower Falls

FIG 4 —Section in canyon below Tower Falls showing upper basalt and upper part of conglomerate resting on andesitic breccias Photograph by Prof O T Jones

In the same line about two miles farther north stands the striking feature known as Junction Butte The capping of the butte is basalt, while the lower part of it is composed of trachytic rhyolite Both here and in other places farther down the canyon, the relation of the basalts to the trachytic rhyolites appears to indicate that these two rocks belong to the same general period of eruption A narrow outcrop of trachytic rhyolite is in fact represented on the geological map directly on the course of the buried canyon more than a mile south of Junction Butte

Holmes has also given a drawing of a sheet of basalt lying on conglomerate about half way down the wall of the canyon, four miles above Tower Falls Again, basalt overlying in places the canyon conglomerate is mapped on the floor of the wide Lamar Valley for a distance of 20 miles above Junction Butte

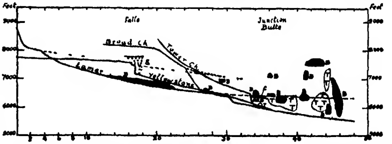

FIG 5 —Longitudinal profiles of Yellowstone and its principal tributaries showing also the lava flow relics in relation to the profiles The black masses labelled B are basalts, the areas marked T are trachytes C indicates the canyon conglomerate near Tower Falls and S the sediments near the Yellowstone Falls.

There is no doubt, therefore, that lava flows entered the Lamar Valley and penetrated for several miles into the canyon, and that near Tower Falls this filling of the older canyon is by a fortunate circumstance still preserved, and it confirms the suggestion made above that the damming of the canyon may have been due to lava flows

If we inquire further into the distribution of the basalt relics that now lie in the flanks of the lower Yellowstone canyon—the 'third canyon' of previous

authors—we find that they rise in places to a level of between 7800 ft and 8000 ft, whereas the highest level attained by the sediments near the Yellowstone Falls is a little above 7800 ft The lava surface stood, therefore at a height sufficient to cause the filling of the upper end of the canyon to its very brim

We turn now to a consideration of the longitudinal profile of the Yellowstone River and its principal tributaries The Lamar Valley profile shows clearly three cycles of erosion—the earliest cycle is only represented by a portion near the head of the valley the second cycle extends down to within about five miles of Junction Butte where the valley of the third cycle begins In the Yellowstone there are three or perhaps even four cycles represented (Fig 5)

There is some doubt whether the part of the valley above the falls or the portion between the two falls should be assigned to the first cycle but it is immaterial in this connexion The main canyon belongs clearly to the second cycle and the third canyon to the third cycle, the second canyon being probably due to a later and postglacial cycle The greater part of Tower Creek pertains to the second cycle and at present hangs conspicuously above the second canyon The profile of Broad Creek which enters higher up the main canyon on the east side is related as to its middle portion to the first cycle and as to its lower portion to the second cycle Evidences of these cycles can also be traced in the transverse profiles of the various canyons If now we project on to these profiles the outcrops of the basalt and trachytic rhyolite relics we find that these descend at their lower ends to within about 100 feet of the river level in the third canyon and at their upper ends attain increasingly greater heights downstream

It follows that these lava flows entered the canyon when the third cycle of erosion was far advanced

Since the main canyon which pertains to the second cycle was eroded through the rhyolitic rocks it is obvious that a great interval of time separates the eruption of the rhyolites and that of the valley basalts which occupied the valleys of the third cycle These considerations render it unthinkable that the basalts and conglomerates near Tower Falls were in existence prior to the eruption of the rhyolites Moreover, there is reason to believe that the surface of the rhyolites had been reduced by prolonged erosion to a peneplain before the initiation of the first cycle of erosion The canyon cycle of erosion thus commenced a very long time after the eruption of the rhyolites, and as a result it is assumed, of successive uplifts, rejuvenation brought about the erosion of the main canyon and later of the third canyon While the latter cycle was far advanced, eruptions of basalt and trachytic rhyolites dammed the canyon and near the falls it was filled to the brim with sediments Erosion was thus arrested and the canyon became a fossil canyon

Since the lava eruptions of the Upper Pliocene the greater part of the lava dam has been removed, leaving only relics here and there as witnesses to the former extent of the lava floods The erosion of the dam allowed of the removal of the sediments and the resurrection of the canyon. The original canyon is therefore an extremely ancient feature, dating probably from the Middle or Lower Pliocene

In conclusion, it gives me great pleasure to put on record the remarkable accuracy of Mr Holmes's observations and his deductions made during the short period when he was examining the geology and physical features of the Park more than fifty years ago

Mineral Industry of New South Wales

THE Department of Mines of New South Wales has issued a very useful volume entitled The Mineral Industry of New South Wales written by E C Andrews and the staff of the Geological Survey and edited by F S Mance Under Secretary for Mines, who contributes two introductory sections Such a work was long overdue in 1901 a similar work entitled The Mineral Resources of New South Wales was produced by Mr Edward F Pittman at that time Government Geologist of New South Wales This book contained a mass of useful information and was in such demand that it has been out of print for many years When Mr Pittman's book was written the most important mineral products of New South Wales were gold copper and tin whereas to day lead zinc and coal are of far greater importance

The general trend of mineral production in the State has been markedly upwards and the value of these productions has risen tremendously The total value of the metals and minerals produced in the State of New South Wales to the end of 1927 is given as close upon 445 million pounds sterling out of which the decade 1918 1927 has contributed no less than 155½ million pounds sterling and there is every evidence that the upward trend is likely to continue

The present work covers satisfactorily the whole field of mineral production it commences with a few brief sections of a general character followed by a description of the occurrences of metals and metallic ores ranged in alphabetical order the only serious exception to this statement may be found in the fact that the four metals silver lead zinc and cadmium are all lumped together mainly for the reason that the ores of these metals are generally found intimately associated Of course by far the most important deposit of these minerals in the State of New South Wales is in the Great Broken Hill deposit one of the most important in the world not only on account of its magnitude, but also because the intimate admixture of ores occurring there has stimulated the ingenuity of inventors to devise processes which have since been applied successfully to deposits in all parts of the world

The third part of the book consists of a description of the occurrences of non metallic minerals also arranged in alphabetical order The term non metallic' minerals is used in its ordinary acceptance compounds of the elements which the chemist would speak of as metals of the alkalis and the alkaline earths being in accordance with ordinary everyday usage spoken of as non metallic substances The work is a very complete one and will no doubt satisfactorily fulfil its object of presenting to the reader a brief but accurate and authoritative description of the mineral wealth of New South Wales

University and Educational Intelligence

CAMBRIDGE —The Director of the Observatory has, with the consent of the Vice Chancellor, reappointed Dr W M Smart of Trinity, as chief assistant at the Observatory for five years

The Sudbury Hardyman Prize at Emmanuel College, offered to a graduate of less than M A standing, has been awarded to A H Wilson for a dissertation on 'Quantum Mechanics Special dissertation prizes have been awarded to C B Allsopp (physical chemistry) and J G A Griffiths (chemistry)

SIXTY NINE 'land grant' colleges and universities have been established in the United States under a series of Acts, beginning in the year 1862, for the granting of land for financing education in agriculture

and the mechanic arts The sixtieth annual report of the Bureau of Education on these institutions (*Bulletin* No 14, 1928) shows that from small beginnings they have by degrees become leading factors in higher education, enrolling, as they do, more than two fifths of all the university and college students in the United States Land grants now provide only a small fraction of their total revenues In 1926-27 the land grants and other federal aid amounted to only four million dollars out of receipts amounting in the aggregate to 137 million dollars Twenty six of them with receipts amounting to 78 million dollars are now combined land grant colleges and State universities Agriculture attracts only a small and diminishing number of students In 1927 only seven and a half per cent of the resident students in the 52 institutions attended by white students were pursuing agricultural courses, while twenty per cent and five per cent were students of engineering and home economics respectively In the 17 negro colleges, out of 7018 students enrolled in regular courses, 965 were studying agriculture, 1672 trades and mechanic arts, and 1630 home economics A comprehensive national survey by the Bureau of Education of the land grant colleges is now in progress

The annual conference of the Association of Teachers in Technical Institutions was held in Liverpool during the Whitsuntide holiday In his presidential address, the new president, Mr A E Evans, of the Battersea Polytechnic, pursued two main arguments which deserve special and serious attention, particularly in view of the educational reorganisation which is now proceeding The first was that local and regional inquiries into the question of education and industry, and the setting up of occasional committees such as those for engineering and salesmanship, are not, in themselves, sufficient to solve the problems which have already received the attention of such national inquiries as those made by the Malcolm and Emmott Committees Both these bodies saw the necessity of establishing a small national committee the duty of which would be to co ordinate local and regional effort and to act as a clearing house for suggestions made towards the solution of the many problems now being presented No concerted national action is possible without such a body, and, until it is set up, only piecemeal attempts at advance can be made While welcoming the recently appointed committee on salesmanship, Mr Evans insisted that production is the first necessity if our industrial problems are to be solved, new methods and new processes must be developed and devised, and new links made between the operations underlying production and the creation of power Mr Evans's second argument was one with which readers of Nature are already familiar In spite of the lip service paid to the new conception of education with which our scientific and industrial civilisation is concerned, there is still a great tendency for educationists to regard with distrust schemes and curricula which deal with the application of science to industry, and to preserve, therefore, an attitude of remoteness from the everyday world They forget, in their adoration of poets and artists and philosophers, the scientific workers, engineers, builders, and architects from whom technical institutions are handing down the means of lightening the burdens of mankind Among resolutions dealt with by the Conference was one on the position of the junior technical school in the educational system It was the result of a lengthy inquiry made by the Association which included special attention to the way in which these schools have been able to satisfy the demands of industrialists for employees able to adapt themselves to the changing needs of industry

Calendar of Patent Records

June 1, 1818—The first French aeronautical patent was that granted to P C Verger on June 1, 1818, for a dirigible airship The ship, in the shape of a fish, was propelled by manually operated fans and was caused to rise or descend by a weight which could be moved along the length of the ship According to the patent specification, successful flights had been made in which the airship had been driven and manœuvred with ease, but there is no other record of these flights The ship bears a close resemblance to that proposed by Pauly and Egg, which had been patented in Great Britain three years earlier

June 4, 1872—Vaseline was patented in the United States by R A Chesebrough, of New York, on June 4, 1872, the word being used for the first time in the specification of this patent It was decided in the British courts that the word became one descriptive of the substance on the lapse of the patent rights in Great Britain, and could not be registered as a trade mark

June 5, 1787—William Symington's steam engine, which was patented on June 5, 1787, was originally intended for a road carriage, but its chief claim to importance lies in the fact that it was used by Patrick Miller in the first practical attempts at steam navigation in Great Britain, a small double hulled paddle boat, with the paddle wheels placed between the two hulls and originally driven by man power, being successfully propelled by it on Dalswinton Lake in 1788 In the following year a larger vessel of the same type was propelled on the Forth and Clyde Canal at a speed of 5 miles an hour, but after a few trials the experiments were abandoned, and were not resumed until the *Charlotte Dundas*, with a new engine, was launched in 1803

June 5, 1854—James Bowman Lindsay was the first to propose a definite scheme for connecting Britain and America by wireless telegraphy His invention for a method of transmitting telegraphic messages by electricity through and across water without submerged wires, the water being made available as the conducting medium, was patented on June 5, 1854 Signals were successfully transmitted across the River Tay (a distance of about ½ mile), and Lindsay calculated that with two stations, one situated in Cornwall and one in Scotland, and two correspondingly disposed stations in America, communication could be obtained across the Atlantic

June 7, 1821—The use of the rocket for the killing and capturing of whales was patented by Sir William Congreve and J N Colquhoun on June 7, 1821 The specification includes a description of the rocket-bomb, which was afterwards re invented in America and became one of the most deadly weapons used in whale fishing

June 9, 1840—It was Thomas Edmondson who first thought of issuing railway tickets in their present form His patent, dated June 9, 1840, had for its object the printing of "cardboard tickets in such a manner that each ticket should bear a progressive number or figure and thus, by being delivered in successive rotation to the passengers, the way bills would be readily made out, a most perfect check could be kept upon all clerks or other officers engaged in receiving money, and a daily or weekly return could be readily made merely by noting the opening and closing numbers of the tickets delivered" The invention comprised a printing machine for printing the cardboard blanks with the proper letterpress and successive numbers, and a dating machine which was put into operation by pushing the end of the ticket into the apparatus.

Societies and Academies

London

Linnean Society, May 2.—**H. H. Haines**: Some aspects of the New Forest, with special reference to the changes wrought by direct or indirect human agency. The poverty of the reproduction of trees and the poor aspect of the young growth is due chiefly to the grazing, browsing, and trampling of domestic animals, as also is the entire composition of parts of the vegetation. The first evident results of excessive browsing is the gradual reduction of the underwood to thorny, prickly, or otherwise distasteful species. The herbaceous flora and fauna are affected by grazing, but also very largely by collectors and the direct action of man in clearing and draining. The impoverishment of the fauna and flora of the open heaths is partly accounted for by too much and too severe burning.—**F. S. Russell**: The Great Barrier Reef Expedition and its aims. The expedition is based on Low Island, forty miles north of Cairns, North Queensland, and situated eight miles from the mainland and midway between the coast and the great barrier itself. The shore party is undertaking an ecological survey of the island and adjacent barrier reef, studies in the growth of coral, and life histories of economic products, and experimental work on the feeding habits of corals are being carried out in the laboratory. The sea work entails a complete seasonal survey of the chemical constituents of the sea water and of the plant and animal plankton, together with physical observations such as temperature and transparency (see NATURE, Jan. 19 and May 18).—**G. Tandy**: The vegetation of the Great Barrier Reef. There is a mangrove swamp to windward (with *Rhizophora mucronata* the dominant) and a more or less vegetated cay of coral sand to leeward as is found on many islands north of Low Island. The formation depends on the South East Trade Wind, which is fairly constant here from April to November. In early morning it will be at S.S.E. and light, but as the day goes on it will shift to E.S.E. or even E. and freshen. The heaviest seas are thus on the north side of the mangrove island, and the drift of the coral shingle is driving the mangrove back. On the lee side of the swamp, however, they are extending in a westerly direction.—**H. W. Pugsley**: A revision of the British *Euphrasiæ*. The British species of *Euphrasia* were first studied by the late F. Townsend, who published a monograph in 1897, adapted from the larger work of Prof. E. von Wettstein of the preceding year. The relationship of the generic subdivisions, as given by Wettstein, is open to criticism.

Paris

Academy of Sciences, April 22.—**Jean Baptiste Senderens**: The preparation of the ether-oxides of the aromatic alcohols by the catalytic action of the alkaline bisulphates. Benzyl alcohol and phenylethyl alcohol are readily converted into the corresponding ethers by the action of sodium bisulphate. Mixed ethers, such as $C_6H_5 - O - CH_2(C_6H_5)$, can be prepared in a similar way.—**J. Herbrand**: Some properties of true propositions and their applications.—**Bertrand Gambier**: Moutard equations with quadratic integrals.—**Ragnar Frisch**: A general formula of the mean.—**Arnaud Denjoy**: A class of analytical functions.—**H. Mineur**: The rotation of the local (star) cluster.—**P. Lejay**: A chronograph recording the ten thousandth of a second and its application to the measurement of the irregularities of astronomical pendulums. A development of the method described in an earlier communication for recording the passage of a pendulum through the vertical without using contacts.—**J. Barthoux**: Badakchan. An outline of the physical and geological features of this Afghan province.—**L. Décombe**: Electrified spherical pellicles and the Stark effect.—**Henri Chaumat**: The calculation of electrostatic machines.—**J. Vuillermoz**: The reversible electromotive force of electrolysis.—**H. Weiss** and **E. Vellinger**: The measurement of the interfacial tension between mineral oils and aqueous solutions. The influence of the degree of refining and of the degree of alteration of the oils.—**S. Piña de Rubies**: The arc spectrum of samarium. Measurements made at the normal pressure between 2750 A. and 2200 A.—**R. Soulillou**: The separation of the various spark spectra of antimony. The spark lines of antimony can be split up into three groups, probably Sb II., Sb III., and Sb IV.; the last two named are perfectly homogeneous, but the first, which is rich in lines, appears to consist of two sub-groups.—**D. Chalonge** and **M. Lambrey**: The continuous spectrum of the hydrogen tube. The influence of the following variables on the intensity of the continuous spectrum of hydrogen has been studied: the pressure of the hydrogen, the intensity of the discharge current, the dimensions of the tubes. The results suggest that it should be possible to use these tubes as standards of intensity in the ultra-violet.—**F. Joliot**: A new method of studying the electro-chemical behaviour of substances in very dilute solution. The velocity of deposition of the substance under examination is determined by measuring the increase in the optical density of a gold or platinum electrode transparent to light, a photoelectric cell being used for the light measurement. Details are given of the determination of the potential of the deposit of bismuth on a gold electrode, the quantities deposited being less than 10^{-8} gm.—**E. Rinck**: The equilibrium in the liquid state between potassium, sodium, and their bromides. The law of mass action, $(Na)(KBr)/(K)(NaBr) = c$, has been verified, and for temperatures from 900° C. to 1000° C. the constant c does not vary appreciably with the temperature. From this it follows that thermal effect of the reaction $Na + KBr \rightleftharpoons K + NaBr$, which at the ordinary temperature is −9.5 cal., is nearly zero at 800°–1000° C.—**F. Bourion** and **Ch. Tuttle**: The cryoscopic determination of the molecular equilibria of resorcinol in aqueous solutions of potassium chloride.—**Jean Calvet**: The corrosion of aluminium. Three specimens of aluminium were used in these experiments, one purified by Hoopes method (99.94 per cent Al), and two commercial metals (99.75 and 99.18 per cent Al). The extra pure aluminium (Hoopes) showed a marked increase of resistance to attack by solutions of hydrochloric, nitric, sulphuric, and phosphoric acids.—**Jean Lugeon**: A method of investigating the atmosphere by means of the disturbances of the electromagnetic field at the time of the passage of a crepuscular band.—**A. P. Dutertre**: The discovery of fossil bones of fishes in the Devonian of the Boulonnais. An account of a new species of *Ganorhynchus* (*G. Rigauxi*) found in the limestone of Ferques at Beaulieu (Pas de Calais). This is comparable with that which has been described and figured by R. H. Traquair under the name of *G. Woodwardi*, and appears to be the only representative of the genus *Ganorhynchus* in Europe.—**A. Paillot**: Bacterial symbiosis and humoral immunity in the Aphides.—**Armand de Gramont**: The application of binocular vision to fixing direction.—**Jean Timon-David**: The action of bromine on insect oils. Figures are given for the hexabromide figure (Hehner and Mitchell method) of several insect oils, and a rough classification is attempted.—**H. Wünschendorff** and **Ch. Killian**: New observations on the

metabolism of *Ustulina vulgaris* —Mme Phisalix Some comparative properties of antirabic sera from vaccinated animals and natural antirabic sera

GENEVA

Society of Physics and Natural History, Mar 7 —**P Balavoine** Observations on ice The water from melted ice is always slightly turbid, this is not a sign of impure water, but is due to the calcium salts crystallised during the solidification failing to redissolve Ice, moreover absorbs ammonia from the surrounding air and water from melting ice may contain ammonia without the original water having been contaminated —**Ed Parejas** Geological observations in Corsica (3) The red deposits of Caporalino This formation occurs at the base of the Neojurassic limestones of Caporalino The latter are mixed with thin layers at their base In the absence of any characteristic fauna, there are as good grounds for correlating the red deposits of Caporalino with the red Oxfordian Argovian of the median Prealps as with the Upper Cretaceous all the more that they appear to lack the Foraminifera usual in the Upper Cretaceous —**A Liengme** The effect of intracardiac injections of adsorbent carbon in the guinea pig and white rat Intracardiac injections of carbon in the form of Indian ink in suspension in physiological serum are innocuous Intracardiac injections in doses of 4 milligrams or more per kilogram of live weight of Merck adsorbent carbon, in suspension of 1 per cent in physiological water cause immediate death Smaller doses produce total loss of muscular tone with clonic shocks in the posterior limbs After several hours of severe discomfort the animal returns to its normal condition Doses of Merck carbon eight times the lethal dose are innocuous if first mixed with a sufficient quantity of fresh human or guinea pig serum **L W Collet** and **Ed Paréjas** The geology of the Hockenhorn The unfolding of the Morcles Doldenhorn nappe has produced a crystalline wedge which has broken its sedimentary covering has scraped it in part, and has even penetrated the opposite side of the layer —**L W Collet** and **G Rosier** A new crystalline wedge in the Inner Faflertal (Lotschental) By the discovery of a new crystalline wedge in the Inner Faflertal the authors point out a correction required in the geological map of the Jungfrau of L W Collet and Ed Paréjas **G Rosier** A granitic mylonite of the Baltschiederlucke, the Bietschhorn massif There is at the Baltschiederlucke a zone of granitic mylonite connected with a plane of over lapping The mylonite contains lenses of crystalline schist of unknown origin, it is composed of albite and microcline cemented by a fine material, consisting for the most part of crushed quartz The microcline, not twinned, can only be identified by Fedorof's method —**A Falconnier** The stratigraphy of the Sequanian in the anticlinal chain of Noirmont, Creux du Cruaz near Saint Cergues The Sequanian there comprises three divisions (1) The lower, with marls and limestones containing *Astarte vocetica*, *Perisphinctes Streuhensis*, *P Fontannesi*, 35 metres, (2) middle reef facies, 60 metres, (3) upper, limestone marl with *Perisphinctes inconditus*, and *P Lothari*, 20 to 30 metres It corresponds with the horizons of the Geissberg, Wangen, and of Baden below the Argovian of the Jura It is defined by zones with *Peltoceras bimammatum* and *Perisphinctes Achilles* of Haug —**J Pilloud** The presence of the upper Lias, the Gault and the Barremian at Voirons (Préalpes externes, Haute Savoie) The discovery of fossils has enabled the author to determine the presence at Voirons of the Gault (zone with *Leymeriella tardefurcata*), of the Barrémian (limestones with Desmoceras), and of the upper Lias (zone with *Lioceras opalinum*) —**R Wavre** The moments of inertia of the terrestrial ellipsoid The author gives a new formula for the constant of precession of the equinoxes, and he extends that of Poincaré to the whole of the equipotential surface exterior to the planet

ROME

Royal National Academy of the Lincei, Feb 17 —**G Scorza** Riemannian matrices With the help of the theory of algebra, together with the results already obtained by the author concerning Riemannian matrices, Rosati's fundamental theorem of matrices may be deduced readily from his observations on the pseudo axes of such a matrix Rosati's statement with regard to the indices of what he calls minimum invariant varieties is contained in propositions already established in the author's earlier publications —**R Marcolongo** The geometrico mechanical investigations of Leonardo da Vinci These investigations are classified into the following groups on lunes and on the quadrature of plane figures limited by circular arcs, on the transformations of solids into equivalent solids under given conditions, on the problem of incidence or Alhazen's problem, on the centres of gravity of plane and solid figures, on the construction of mathematical instruments Leonardo discovered and demonstrated the theorem of the meeting point of the axes of a tetrahedron but it does not appear that he showed this to be the barycentre of the tetrahedron For the centre of gravity of a semicircle he not only gave an approximate calculation, but he also used the method of decomposition into elementary sectors, thus reducing the problem to that of the graphic composition of a system of parallel forces With slight variations, his precision compasses are still sold, and he designed also a parabolic compass **A Amerio** New method for measuring the velocity of sound in liquids In this method, use is made of the very sensitive property of the ear which allows it to determine the direction of origin of a sound when this lies in the horizontal plane passing through the ears —**S Franchi** The importance of the San Remo and Imperia sheets of the 1 100,000 geological map of Italy for the solution of questions of Alpine and Apennine geology —**A Comessatti** The curves of Galois (1) —**T Boggio** Riemann's homograph for the hyper surfaces of a curved space —**S Cherubino** Decompositions in sums of squares of definite and semi definite polynomes —**E Bompiani** The elements of the second order of curves of a surface In previous notes the convenience of associating, with an element of the second order of a curve traced on a surface of ordinary space, two quadrics termed asymptotic osculatory quadrics of the element, was indicated Considerations analogous to those evolved in these notes point to the possibility of associating with such an element two new quadrics, of which the equations are now given —**N Moushkhelichvili** The problem of the torsion of isotropic elastic cylinders —**A Masotti** The dynamic actions in a system of rectilinear vortices —**G B Lacchini** The limits of visibility with refractors of small dimensions —**A Carrelli** Broadening of lines by resonance (2) Experimental results are given which, in conjunction with those of the author's previous communication on this subject, show that the widening of a spectral line in emission varies as the square root of the concentration of the vapour, and that the distribution of the intensities follows an exponential law These conclusions were derived by Holtzmark on the basis of the theory of absorption founded on the mutual action of similar resonators —**Angelina Cabras** Functional operations of mathematical physics represented as rational

functions of the symbol of derivation - **B Rossi** The Raman effect and negative absorption The Raman effect is usually regarded as an experimental proof of the induced emission or negative absorption postulated by Einstein in his deduction of Planck's formula Closer examination of this interpretation reveals difficulties Thus, if Einstein's induced emission resembles a Raman effect of the second species, it should possess a frequency double that absorbed or emitted spontaneously by the atom Exact analysis shows that the corpuscular theory of light renders it possible to unite the Raman effect and the phenomena of absorption and emission (spontaneous and induced) in a coherent scheme according to which the Raman effect of the second kind is considered as a super elastic impact of a light quantum with an excited atom and induced emission as a modification of the probability that an atom will emit a radiation of given frequency as a result of the presence of other quanta of the same frequency - **G Malquori** The system, $Fe(NO_3)_3 - HNO_3 - H_2O$ at 25° Study of this system gives results which exclude the existence of the acid salt $Fe_2O_3\ 4N_2O_5,\ 18H_2O$ and indicate the presence in solutions highly concentrated as regards nitric acid of the solid phase $Fe(NO_3)_3,\ 6H_2O$ —**D Bigiavi** and **S Stefanic** Action of diazotates on azoxyphenols When treated with bromophenyldiazonium hydroxide, *a* benzeneazoxyphenol yields directly the corresponding hydroxyazo compound, whereas its β isomeride gives a diazo ether, which is able to undergo coupling with β napthol and also rapid transformation into the isomeric hydroxyazo compound —**V Montoro** The supposed sesquioxide of molybdenum According to Guichard (1901), molybdenite is converted into the compound Mo_2S_3 when heated in a carbon crucible in the Moissan furnace for four minutes by an arc carrying 900 amperes at 50 volts X ray examination of a number of specimens of molybdenite partially desulphurised in this way shows however, that these consist of mixtures of the disulphide with solid solutions of carbon in molybdenum This result confirms Parravano and Malquori's conclusion drawn from an investigation of the equilibrium of the reduction of molybdenite by hydrogen, that no molybdenum sulphide exists which is less rich in sulphur than the disulphide —**L Passerini** Investigations on spinels The compound $MgCr_2O_4$, obtained by calcining a mixture of the nitrates of the two metals at about 800°, and $NiFe_2O_4$, similarly obtained from the corresponding hydroxides, crystallise in the cubic system with a lattice structure of the spinel type For $MgCr_2O_4$ the side of the unit cell is $a = 8\ 290 \pm 0\ 005$ A, the volume of the cell $v = 569\ 72 \times 10^{-24}$ c c, and the calculated density 4 49, for $NiFe_2O_4$ the corresponding magnitudes are $8\ 340 \pm 0\ 005$ A, 580 09 $\times 10^{-24}$ c c, and 5 268 respectively —**C Antoniani** and **G Fonio** Investigations on the interchange of the phosphoric acid of the soil with arsenic acid When soil which has been treated with sodium phosphate is afterwards treated with dilute arsenic acid solution, the phosphate anion is replaced to some extent by the arsenic anion —**G Mezzadroli** and **E Vareton** Action exerted by an oscillating metallic circuit on the germination of seeds Experiments with beans, wheat, barley, and beet show that the presence of an oscillating circuit with a single coil, 30 cm in diameter, capable of catching natural cosmic waves of wave length about 2 metres, exerts a favourable influence on the germinating power of seeds, the time of germination being reduced, in some cases, by one half —**M Cassinis** and **L Bracaloni** Hydremic curves —**B Aloisi** Hæmolytic poisons and alterations of the liver

Official Publications Received

British

Sugar Beet Problems Report of Second Conference held at the College on Wednesday January 23rd 1929 Pp 44 (Newport Salop Harper Adams Agricultural College)

The Cultivation and Manuring of Sugar Beet Pp 23 (Newport, Salop Harper Adams Agricultural College)

Royal Botanic Gardens Kew Bulletin of Miscellaneous Information, 1928 Pp iv+411+103 (London H M Stationery Office) 12s 6d net

The Journal of the Royal Agricultural Society of England Vol 89 Pp 8+372+clxxiv+xii (London John Murray) 1s

Manchester Municipal College of Technology Summer Evening Classes Prospectus of Short Courses of Lectures and Laboratory Work to be given during the Summer 1929 Pp 26 (Manchester)

Survey of India Geodetic Report Vol 3 From 1st October 1925 to 30th September 1926 Pp xi+73+3 plates+6 charts 3 rupees 5s 3d

Records of the Survey of India Vol 22 Exploration of the Shaksgam Valley and Aghil Ranges 1926 By Major Kenneth Mason Pp xi+182+16 plates 3 rupees 3d (Dehra Dun)

University Grants Committee Returns from Universities and University Colleges in receipt of Treasury Grant 1927 1928 Pp 24 (London H M Stationery Office) 8 net

The Journal of the East Africa and Uganda Natural History Society Nos 33 and 34 May and September 1928 Pp 73+26 plates (Nairobi) To Members 7s 6d to non Members 1s

The National Institute for Research in Dairying its Work and Needs Second edition Pp 60 (Reading)

Proceedings of the Cambridge Philosophical Society Vol 25 Part 2 April Pp 121 254 (Cambridge At the University Press) 7s 6d net

The Scientific Proceedings of the Royal Dublin Society Vol 19 (N S) No 20 A Study of Lactose fermenting Yeasts isolated from Milk Cream and Butter By M Grimes and J Doherty Pp 81 84 (Dublin Hodges Figgis and Co London Williams and Norgate Ltd) 6d

British Science Guild The Annual Report of the Executive Committee 1928 9 presented at the General Meeting of Members held at the Hotel Cecil Strand London 8th May 1929 Pp 8 (London) 1s

Memoirs of the Asiatic Society of Bengal Vol 11 No 2 The Language of the Mahu Naya Prakasa an Examination of Kashmiri as written in the Fifteenth Century By Sir George A Grierson Pp ii+73 130 (Calcutta) 24 rupees

Indian Journal of Physics Vol 3 Part 3 and Proceedings of the Indian Association for the Cultivation of Science Vol 12 Part 3 Conducted by Prof C V Raman Pp 307 4 0 (Calcutta) 3 rupees 4s

Papers and Proceedings of the Royal Society of Tasmania for the Year 1928 Pp v+191+8 plates (Hobart) 10s

Dominion of Canada Report of the Department of Mines for the Fiscal Year ending March 31 1928 (No 2182) Pp vi+6 (Ottawa F A Acland) 1 cents

Canada Department of Mines Geological Survey Summary Report 1927 Part A (No 2162) Pp 65A Summary Report 1927 Part B (No 2172) Pp 94B (Ottawa F A Acland)

Transactions and Proceedings of the Royal Society of South Australia (Incorporated) Vol 52 Edited by Prof Walter Howchin assisted by Arthur M Lea Pp iii+ 76+22 plates (Adelaide) 17

Southern Rhodesia Report of the Director Geological Survey for the Year 1928 Pp 18 (Salisbury S R)

Modern Safety Rules for use in Chemical Works Part 1 Model Rules Pp 30 (London Association of British Chemical Manufacturers)

Proceedings of the Society for Psychical Research Part 110 Vol 38 May Pp 281-408 (London Francis Edwards Ltd) 5s

The Scottish Forestry Journal being the Transactions of the Royal Scottish Arboricultural Society Vol 43 Part 1 March Pp iii+80+31 (Edinburgh) 7s 6d

The Journal of the Institution of Electrical Engineers Edited by P F Rowell Vol 67 No 380 May Pp 7 684+xxxviii (London E and F N Spon Ltd) 10s 6d

The Linen Industry Research Association Report of the Council 1928 Pp 24 (Lambeg Co Antrim)

Agricultural Progress the Journal of the Agricultural Education Association Vol 6 1929 Pp 157 (London Ernest Benn Ltd) 5s net.

Tanganyika Territory its Geology and Mineral Resources Pp 8 (Dodoma Geological Survey)

Proceedings of the Royal Society of Edinburgh Session 1928 1929 Vol 49 Part 2 The Thermal Equilibrium between Ethylene Iodine and Ethylene Di Iodide By R. B Mooney and Dr E B Ludlam Pp 160 169 (Edinburgh Robert Grant and Son London Williams and Norgate Ltd) 1s

Foreign

Carnegie Endowment for International Peace Division of Intercourse and Education Annual Report of the Director for the Year 1928 By Nicholas Murray Butler Pp 98+7 plates (New York City)

The Science Reports of the Tohoku Imperial University Sendai Japan Second Series (Geology) Vol 13 No 1 Pp 15+8 plates (Tokyo and Sendai Maruzen Co , Ltd)

Proceedings of the Third Pan Pacific Science Congress Tokyo October 30th-November 11th 1926 held under the Auspices of the National Research Council of Japan and through the Generosity of the Imperial Japanese Government. Vol 1 Pp. x+1220 Vol 2 Pp xvi+1221 2678 (Tokyo National Research Council of Japan)

Territory of Papua. Native Education the Language of Instruction and Intellectual Education By F E Williams (Anthropology Report No. 9) Pp. 25 (Port Moresby Government Printer)

Scientific Papers of the Institute of Physical and Chemical Research Nos 186-187 A Rosy Muscovite from Suzawa and a Dark grey Muscovite from Doi by Satoyasu Iimori and Jun Yoshimura A Pink Kaolin, and Ruthenium as a Minor Constituent of the Tanokami Kaolins by Satoyasu Iimori and Jun Yoshimura. Pp 221 228 (Tokyo Iwanami Shoten) 20 sen

Journal of the Faculty of Agriculture Hokkaido Imperial University, Sapporo Japan Vol 22 Part 2 Über den Einfluss meteorologischer Faktoren auf den Baumzuwachs II Untersuchungen uber das Langenwachstum einer Schwarzkiefer unter Verwendung eines neuen Höhenzuwachsautographs Von Hirokichi Nakashima Pp 301 327+Tafel 10-15 Vol 20 Supplementary No A Monograph of the Dibranchiate Cephalopods of the Japanese and adjacent Waters By Madoka Sasaki. Pp v+357+30 plates (Tokyo Maruzen Co Ltd)

Proceedings of the United States National Museum Vol 75 Art 2 Beetle Larvae of the Subfamily Galerucinae By Adam G Böving (No 2774) Pp. 48+5 plates Vol 75 Art 4 A Review of the Birds of the Islands of Siberut and Sipora, Mentawi Group (Spolia Mentawiensia). By J H Riley (No 2775) Pp 45+1 plate Vol 75 Art 8 Notes on some North American Moths of the Subfamily Eucosminae By Carl Heinrich (No 2779) Pp 23+5 plates Vol 75 Art. 6 Some New Genera and Species of Nematode Worms, Filarioidea from Animals dying in the Calcutta Zoological Garden By Asa C Chandler (No 2777) Pp. 10+8 plates (Washington D C Government Printing Office)

U S Department of Agriculture Farmers Bulletin No 1588 Frost and the Prevention of Frost Damage By Floyd D Young Pp 62 (Washington D C Government Printing Office) 10 cents

Department of Commerce Bureau of Standards United States Government Master Specification No 28c Lamps Electric Incandescent Large Tungsten Filament Pp ii+8 5 cents United States Government Master Specification No. 618 Lamps Electric Incandescent Miniature Tungsten Filament. Pp. ii+8 5 cents (Washington D C Government Printing Office)

Sudan Notes and Records Vol 11 1928 Pp iv+242 (Khartoum Sudan Notes and Records London Sudan Government Office) 30 P T 6s

University of Illinois Engineering Experiment Station Bulletin No 189 Investigation of Warm Air Furnaces and Heating Systems The Research Residence Part 4 By Prof Arthur C Willard, Prof Alonzo P Kratz and Prof Vincent S Day Pp 114 60 cents Bulletin No 190 The Failure of Plain and Spirally Reinforced Concrete in Compression By Prof Frank E Richart Anton Brandtzaeg and Rex L Brown Pp 72 40 cents (Urbana Ill)

Suomen Geodeettisen Laitoksen Julkaisuja No 11 Die Beobachtungsergebnisse der Triangulation in den Jahren 1926-1928 Pp ii+139 (Helsinki)

A Series of Fourteen Radio Talks on Science for the Home Manager By Dr George D Beal H S Coleman E R Harding Dr O F Hedenburg, R H Heilman L E Jackson Dr H M Johnson H M Marc H K Salzberg Dr Erich W Schwartze, Dr T H Swan Dr R B Trusler Dr O E Jennings. (Radio Publication No 48 University of Pittsburgh) Sponsored by Mellon Institute of Industrial Research and Broadcast from the University of Pittsburgh Studio of KDKA Westinghouse Electric and Manufacturing Co Pittsburgh, Pennsylvania, 1929 Pp 198 (Pittsburgh Pa. University of Pittsburgh) 75 cents

Proceedings of the Imperial Academy Vol 5 No 3 March Pp v vi+103 160 (Tokyo)

Preussische Staatsbibliothek Handbibliothek des grossen Lesesaals Abteilung 7 Mathematik und Naturwissenschaften Pp viii+75 (Berlin Staatsbibliothek)

Japanese Journal of Mathematics Transactions and Abstracts Vol 5 No 4 March Pp iv+269-367+13 59+vi+ix Vol 6 No 1 March Pp. 171 (Tokyo National Research Council of Japan)

Proceedings of the California Academy of Sciences Fourth Series Vol 18 No 12 The Faunal Areas of Southern Arizona a Study in Animal Distribution By Harry S Swarth Pp. 267 288 (San Francisco)

Bulletin of the American Museum of Natural History Vol 59, Art. 1 Pelmatozoan Root Forms (Fixation). By Kurt Ehrenberg Pp 76 (New York City)

The University of Colorado Studies Vol 17 No 1 Pp ii+44 (Boulder Colo) 1 dollar

Koninklijk Nederlandsch Meteorologisch Instituut No 102 Mededeelingen en Verhandelingen 29b Klimatologie van den Indischen Oceaan Door P H Gallé (With English Summaries.) Pp. 84 0 75 fl No 102 Mededeelingen en Verhandelingen 30 The Influence of Sea Disturbance on Surface Temperature By P M van Riel Pp. 17 0 30 fl No 106a Ergebnisse aerologischer Beobachtungen 16, 1927 Pp iv+44 2 50 fl No 108 Seismische Registrierungen in De Bilt. 14 1926 Pp ix+68 1 00 fl (Amsterdam Seyffardt s Boekhandel)

Catalogues.

Watson s Microscope Record No 17 May Pp 32 (London W Watson and Sons Ltd)

Preliminary Summer List, 1929 Pp. 4 (London W Heffer and Sons Ltd)

Liver Therapy some Clinical Evidence of its Value in Pernicious Anæmia. Pp. 8. (London The British Drug Houses Ltd)

Diary of Societies

FRIDAY May 31

Royal Institution of Great Britain at 9 —Prof E N da C Andrade The Air Pump Past and Present.

MONDAY, June 3

Royal Geographical Society (at Lowther Lodge), at 4 —Special General Meeting.

Victoria Institute (at Central Buildings, Westminster), at 4 30 —Sir Ambrose Fleming Nature and the Supernatural (Presidential Annual Address).

Royal Society of Edinburgh, at 4 30 —Prof. W C M'Intosh On Abnormal Teeth in certain Mammals, especially in the Rabbit.—Dr I Sandeman Bands in Hydrogen related to the Fulcher System.—J A V Butler and W O Kermack The Action of Salts of Polynuclear Bases on Colloidal Suspensions and on the Electro-capillary Curve.—Sir Thomas Muir The Theory of Skew Determinants and Pfaffians from 1891 to 1919

Royal Institution of Great Britain at 5 —General Meeting

British Psychological Society (Education Section) (at London Day Training College) at 6 —Miss E M Terry Individual Difficult Children

TUESDAY June 4

Institution of Gas Engineers (at Institution of Civil Engineers) at 10 A M —Annual General Meeting (continued on June 5, 6 and 7).

Royal College of Physicians of London at 5 —Dr H H Dale Some Chemical Factors in the Control of the Circulation (Croonian Lectures) (I)

London Natural History Society (at Winchester House E C), at 6 30 —H J Burkill The Yorkshire Derwent

Illuminating Engineering Society (Annual General Meeting) (at Royal Society of Arts) at 7 —Dr J F Crowley Some Further Applications of Synchronously Intermittent Light for Revealing Moving Machinery

WEDNESDAY, June 5

Entomological Society of London, at 8 —Dr H Scott An Entomological Excursion into Basuto Land

THURSDAY June 6

Royal Society at 4 30 —Prof E A Milne The Structure and Opacity of a Stellar Atmosphere (Bakerian Lecture).

Institute of Pathology and Research (St. Mary s Hospital), at 5 —Prof W Bulloch The History of Bacteriology

Royal College of Physicians of London at 5 —Dr H H Dale Some Chemical Factors in the Control of the Circulation (Croonian Lectures) (II)

Chemical Society at 8 —F Challenger L Klein and T K Walker The Production of Kojic Acid from Pentoses by *Aspergillus Oryzæ* —Prof T M Lowry and G Jessop The Properties of the Chlorides of Sulphur Part II Molecular Extinction coefficients —M S. Lesslie and E E Turner The Isomerism of Derivatives of 2 phenylnaphthylene 1 8-diamino —Prof T M Lowry and F L Gilbert Studies of Valency Part XIII Further Experiments on the Molecular Structure and Configuration of the Quadrivalent Derivatives of Tellurium

FRIDAY June 7

Genetical Society (at Linnean Society) (Annual General Meeting), at 3 —Prof D E Lancefield The Genetics of *Drosophila obscura* —Dr C Stern Some Recent Work on *Drosophila*

Philological Society (at University College) at 5 30 —Dr C T Onions The Supplement.

Geologists Association (at University College) at 7 30 —Dr A K Wells Dr A. Brammall and others Discussion on The Value of Petrographic Character as a Criterion of Age

Royal Institution of Great Britain at 9 —C Leonard Woolley Excavations at Ur 1928–29

CONFERENCES

June 5 to 8

South Eastern Union of Scientific Societies (at Brighton).

Wednesday June 5 at 2 45 —W C Wallis Brighthelmstone of Early Times.—Sir Arthur Smith Woodward The Willett Collection of Chalk Fossils.

At 8 —Sir Arthur Keith Southern Englishmen of the Pre Roman and Roman Period (Presidential Address).

Thursday June 6 at 11 A M —A H Allcroft Archæological Address —A D Cotton The Importance of the Study of Systematic Botany

At 12 —J H Pull The Blackpatch Excavations.—G Morgan The Etiology of Sphæroblasts or Wood nodules

Friday June 7 at 11 A.M —H Dewey The Denudation of the Weald —Dr G P Bidder Death (Address).

At 12 —E A Martin The Brighton Rubble Drift, and Cliff Formation —A. Griffith Some Sussex Birds and Insects

At 8 —Reginald A Smith Early British Art (Public Lecture).

Saturday June 8, at 10 30 A.M —Prof H J Fleure Regional Survey Address.

At 11 30 A.M —D Edwards Town and Regional Planning.

June 6 to 15

International High Tension Conference (at Paris)

June 11 to 22.

Institution of Electrical Engineers.—Summer Meeting in France

PUBLIC LECTURES.

FRIDAY May 31

Chelsea Physic Garden, at 5.—H. V Taylor Supplies from the Vegetable Kingdom and the Public Health (Chadwick Lecture).

MONDAY, June 3.

King s College, at 5 30.—Prof P Karrer Organic Chemistry (Succeeding Lectures on June 5 and 6.)

FRIDAY, June 7

King s College, at 5.30 —Prof. H. Wildon Carr The Philosophy of Leibniz. (Succeeding Lectures on June 10, 12, 14, 17, and 19)

SATURDAY, JUNE 8, 1929

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No 3110 Vol 123]

School Science

THOSE in touch with educational circles have been aware for some time past of a growing dissatisfaction with the scope and treatment of school science The Report of the Committee of the British Association upon Science in School Certificate Examinations[1] thus comes at an opportune moment, and will be welcomed by all who realize the difficulties of the present position It is not an easy matter to probe to the root of the widespread feeling that all is not well with science in the schools, but at bottom there seems to be a conflict between utilitarian and æsthetic ideals Many teachers recognizing that the majority of their pupils will have to work hard for a living, feel that they must be given instruction of immediate practical value others emphasize the importance of training young people to appreciate to the full the serene joys of the intellectual life These two aims are not necessarily incompatible and their reconciliation might be effected with reasonable ease, were not the situation rendered almost hopelessly rigid by the incubus of examinations

There are in England and Wales eight examining bodies which conduct First and Higher School Certificate examinations taken by boys and girls at the ages of 16 and 18, or thereabout, respectively Through the activity of the Secondary School Examinations Council, these several examinations have been closely equated, and there is now little variation among them in syllabus and standard This uniformity is in many ways a good thing, but the disastrous result of a comprehensive yet stereotyped examination system has been to stifle originality in teaching, and to raise the list of examination successes into a fearful idol, to be at once worshipped and dreaded The effect upon science has been particularly devastating, owing to the special circumstances Science is a comparative new comer to the school curriculum, and a mere half century's experience has proved insufficient to enable teachers to work out the most suitable and efficient means of teaching it Yet, while still in this immature state, school science is becoming petrified by examination requirements, and the evil habit of 'cramming' is likely to establish itself firmly unless immediate steps are taken to prevent the catastrophe

The Committee not only points out the danger, but makes valuable suggestions for avoiding it It favours a scheme whereby schools may arrange

[1] British Association Reprints No 23 Report on Science in School Certificate Examinations Pp 443 532 (London British Association, 1928) 1s

their own plan of work, and examine their own pupils in association with independent boards of assessors Such a scheme is already in operation in certain technical schools, where a national certificate is awarded under the joint supervision of the Board of Education and the Institution of Mechanical Engineers, and a similar scheme has been adopted by the University of London for the examination of the twenty-two training colleges allotted to it If a system of this kind were generally adopted, with adequate safeguards, teachers would have far more freedom to elaborate methods and courses of work suited to particular needs, and school science would have the opportunity of advancing on the lines of true culture

Present conditions are responsible for a further regrettable tendency in elementary science teaching, namely, a concentration upon formal chemistry, physics, and, to a less extent—principally in girls' schools—botany Although something may be said for such a study at the stage of the Higher Certificate, it is very doubtful whether boys and girls of 14 to 16 really derive any great permanent benefit from a diluted form of academic science The 'theory' of chemistry and physics, and even of botany, is in fact not appropriate to the general education of the middle school A few bright pupils may benefit, but teachers and examiners alike realize that most of the candidates are drowned in a boundless sea of definitions, laws, and hypotheses, of a depth to them unfathomable

Still another conspicuous defect in school science is the infrequency with which biology forms a part of the regular routine Whatever we may regard as the primary aims of teaching science to boys and girls, we must certainly include among them that of imparting an elementary knowledge of the phenomena of life It is therefore extremely disconcerting to find that many, if not most, of our children may pass through the schools without receiving any instruction whatever in biology There are, of course, explanations of this remarkable state of affairs In the first place, the majority of science teachers have specialized in chemistry or physics, or both, at the universities, and are thus content, in general, to teach those subjects only, at any rate, no active demand for biological work is likely to proceed from teachers of the exact sciences unless a stimulus is applied from without Secondly, it has been—and is—maintained that biology has too recently emerged from the purely descriptive stage to lend itself to the inculcation of scientific method, whereas chemistry and physics may be very easily adapted to this end Lastly, we are reminded that biology is based largely upon chemistry and physics, and that logic consequently demands a study of at least the elements of the two latter sciences as a necessary preliminary to biological work It is clearly an urgent matter for the biologists to show how these difficulties can be removed

Such are the principal facts relating to the present condition of science in schools It remains to consider them in relation to the strife between æsthetic and utilitarian ideals which we believe to be the real cause of the prevailing controversy Since modern civilization depends for its very existence upon the application of scientific knowledge, no one will deny the importance of teaching young citizens a modicum of scientific facts Moreover, technical occupations absorb increasingly large numbers of workers, and must continue to do so as long as civilization persists it may thus be of direct practical and financial value to a boy or girl to get elementary technical instruction at as early an age as possible These two points are, in brief, the arguments of the utilitarian school, and they undoubtedly have much weight If they carry the day, they will tend to preserve the existing scheme of formal chemistry and physics, and to exclude biology until biological callings have increased to such an extent as to offer wide and immediate prospects

Even those teachers, however, who most strongly urge the utilitarian aims agree that science, as part of a general education, should do more than impart useful information There is, in fact, an almost universal feeling that the æsthetic side of science is ultimately the most vital, but opinions differ as to the degree and manner in which this aspect is to be emphasized Stern disciplinarians, who themselves experience an austerity of pleasure in fundamental scientific philosophy, make superhuman efforts to transmit some shadow of this pleasure to restive school certificate sets, the rare occasions on which their labour gets the full appreciation it deserves are a sufficient recompense for many failures It is a commonplace that such teachers are usually regarded with no little reverence by their pupils in after years, but the reverence is rather for the man than for his teaching

There are, again, those teachers who strive 'to make science easy', and in doing so run dangerously near the borderline of insipidity scientific facts, as such, are of no greater educational worth than the date of Waterloo or the names of Henry VIII's wives To know how an electric bell works is not necessarily to be educated It is seductively

attractive to make one's science course a series of superficial explanations of devices and phenomena, and to imagine that one is revealing the beauties of science

This has been the chief criticism levelled at 'everyday science', 'science for all', or 'general science', but it is a criticism easily disposed of, since it rests upon a misunderstanding The advocates of general science' have been envisaged as those who would replace the very real (if limited) benefits of formal science by the illusory returns of a shallow smattering Nothing could be farther from the truth 'General science', as properly interpreted by the Committee, is an attempt to make children see science steadily and to see it whole, to enable them to assimilate scientific principles and scientific method by a consideration of phenomena from the point of view of every relevant branch of science and to increase their capacity for intellectual pleasure by opening to them the inexhaustible treasures which science discovers in the world of everyday life The 'general scientists', in fact, are thorough going supporters of the æsthetic aim, though sometimes they disguise their real sentiments by pointing out the immediate practical value which the course they suggest may possess It is true that a scheme of 'general science' may include lessons on severely practical topics, but the whole spirit of the course is to relegate the purely utilitarian aim to a definitely lower place

Unfortunately, 'general science' has to fear two extremely serious perils The first is that it can so easily be transformed into a grotesque caricature, becoming, indeed, the smattering which it strives to avoid The second is that it is incomparably more difficult to teach than the formal chemistry or physics or botany at present in vogue If it is to achieve its purpose, the first essential is to dispel the notion that 'general science' is a soft option, to be welcomed for the sake of weaker candidates, but otherwise to be disparaged This difficulty in teaching will, we fear, be very troublesome to overcome, but examining bodies may do something by encouraging schools to take general science, and by allowing a wide choice of questions in the papers

Specialization at the later stage, that of the Higher Certificate, is probably inevitable Yet we admit surprise at the qualified blessing which the Committee gives to the Higher Certificate Examination, for we cannot bring ourselves to believe that it is good for boys and girls of 16 18 to devote three quarters of their school time to the study of only two or three special subjects We should like to see a broader basis for the examination, with a less intensive treatment Similar remarks apply to the university scholarship examinations, which demand what is practically degree knowledge from the candidates, and do more to sophisticate adolescent education than any other single factor E J HOLMYARD

The Place of Science in our View of History

The History of British Civilization By Dr Esmè Wingfield Stratford Vol 1 Pp xv + 574 Vol 2 Pp viii + 575 1332 (London George Routledge and Sons, Ltd , New York Harcourt, Brace and Co , Inc , 1928) 42s net

ON several occasions the pages of NATURE have afforded evidence of the growing importance taken by science in the writing and teaching of history It is in fact at the root of the difficulty which was dealt with recently in one of the leading articles How to secure that our political leaders and one might well add leaders of all other kinds—should approach their business in a scientific spirit? There are, of course, many ways by which the change will come, and is coming, but it may be doubted whether any way will affect a larger number of persons than that of infusing the ordinary teaching and view of history with some notion of the part that science has played in the process For we all learn some history Not only at school but also in after life so far as we do any serious reading at all, it is of a historical kind floods of memoirs and biographies are being constantly poured out by the press

Here is the main source of intellectual influence which is playing upon the more thoughtful sections of the public, it is here that science must make its way It is therefore an interesting study—more interesting every time—to measure the space which science occupies in works of general scope, especially when they purport to talk of civilisation as a whole, and, most of all, of modern civilisation Such a book has just appeared in Mr Wingfield Stratford's "History of Civilization", which has had a remarkably good press and promises, if he can induce his publishers to produce a cheaper edition to have a powerful influence in forming British opinion about its own past It has all the elements of sound popularity for an English public, a vigorous full blooded style, a freedom of personal judgment, an absence of pedantry or the apparatus of learning, a readiness to admit national crimes and defects, and a glorious ending on the right side, with the British Commonwealth of

Nations standing for the cause of humanity, and encompassed by the greater League of all nations

It is a capital and most interesting book, well deserving its success But we are looking at it here from the special point of view of science, and in that respect it marks an advance, and yet, even perhaps more strongly, shows where the next advance must follow Some six or eight short sections out of 1300 pages are given to an account of the men of science themselves, who, except Roger Bacon, are justly appreciated, and the right place of science, in first accelerating and then controlling the Industrial Revolution, is well indicated This is something to be thankful for, much more and in a better spirit than in the books of our youth, where we were lucky if we found Newton mentioned at all, even as Master of the Mint

It is still very inadequate, however, and we should like to make the inadequacy patent to Mr Wingfield Stratford and any other open minded writer of books on history by two considerations, one of a particular and the other of a general kind To take the particular example first He gives us pages of a highly amusing and instructive kind on the progress of Mr Bernard Shaw to fame, his shameless self advertisement, his gibes and clever plays He does not do this on account of his socialism, for it does not appear that the author is a socialist He does it because of its personal interest and because in the end Mr Bernard Shaw did attain the notoriety at which he aimed No doubt also it is one of the reasons why we find the book so interesting Now just at this time one of the greatest pieces of scientific construction in the history of mankind was going on, the development of the new astronomy which has given us the amazing view of the universe which fills the mind of all who have approached it with a fresh unquenchable curiosity and the profoundest admiration for its creators It happens that the two most prominent names in this army are Englishmen, Jeans and Eddington, and their work must have a lasting influence on the way we both think and act Yet in the book before us there is not a word about it

That is one of many cases which might be quoted from a book in which the general spirit of the author is quite favourable to science If these things are done in the green tree—— ? The general criticism connected with this is more intangible and may not carry conviction so readily to every mind This book, and most surveys of modern history, end on a note of poignant resignation, not of despair but of horror and uneasiness, of hope against hope We believe this tone to be largely due to the divorce of the literary mind from science The literary mind being personal, sensitive, and often ephemeral, is naturally obsessed by the suffering and tragic conflicts of the War It is right that we should have these things brought prominently before us A heartless science would be worse than untutored savagery But it is essential that those who aim at putting forward a general view of human progress, which is what a history of civilisation must mean, should have regard to the dominant and lasting factors

On this view, what is the most striking fact about the world towards the end of the nineteenth century and the beginning of the twentieth, above all in the throes of the War ? Surely its stability in spite of conflict, its recovery in spite of stupendous loss Were a stranger from Mars to visit this planet without a knowledge of what we have gone through in the last fifteen years, he would not report a scene of desolation or decadent idleness or internecine strife, but a hive of industry, a network of intercourse, a fertility of invention, and a range of thought which, on inquiry, would appear far to exceed anything in the human record The black spots, such as parts of China and Russia, would also on inquiry be found to be precisely those places where the organisation, provoked and carried out by scientific thinking, were the least developed

It is curious that this, which will certainly be the most commonplace observation about twentieth century civilisation by the historians of the future, is at present so rarely made It is due no doubt to the political and still more the literary preoccupation of the bulk of contemporary historians The League of Nations is gradually but with difficulty fighting its way into the pages of history and the everyday thinking of mankind But the foundations of the League, which lie much more in the cultural, economic, and scientific region than in the declarations of statesmen, have still to be dragged into the daylight The activities of commerce and transport, the agreements as to disease, hygiene, slavery, and the like, above all the supreme constructions of the mind, such as the new cosmogony instanced above, are all international and—in the broad sense—scientific, and, until the historians come to their work with a mind awake and to some extent instructed on this side, justice will not be done to the most vital aspects of the modern world Above all books, a 'history of civilisation' should give due place to these things, for what is modern civilisation if we leave out science ?

F S MARVIN

Statistical Mechanics

Statistical Mechanics the Theory of the Properties of Matter in Equilibrium Based on an Essay awarded the Adams Prize in the University of Cambridge, 1923–24 By R H Fowler Pp viii + 570 (Cambridge At the University Press, 1929) 35s net

THE motion of a given conservative dynamical system is a problem which can be reduced to the consideration of the properties of the functions defined by its Hamiltonian equations of motion These equations are themselves deduced by allowing infinitesimal departures of the system from its actual course In an endeavour to base the laws of thermodynamics on mechanical grounds, Maxwell, Boltzmann, and Clausius were led to consider assemblies of similar systems, each possessing its own configuration and velocities Even were it possible to describe minutely the configuration at a given time of each member of an assembly consisting of a large number of such systems, it is doubtful whether our senses would be acute enough to appreciate the implications of such a description

There is, however, another direction in which such inquiries may be pursued, namely, in an investigation of the law of distribution at a given instant of all the systems among the various possible configurations and velocities The number of systems which fall within given infinitesimal limits of configuration and velocity will in general depend not only on the generalised co ordinates and momenta, but also on the time Where this dependence does not involve the time, we have statistical equilibrium The problem which is now of paramount interest is the search for the normal or time average properties of such an assembly The only method of finding these averages which is amenable to exact treatment appears to be an identification of them with averages taken over the accessible phase space of many dimensions by means of which the configuration and velocities of the assembly may be described

The average value of statistical mechanics may be regarded, as indeed they were by Boltzmann, Gibbs, and Planck, as values of maximum frequency of occurrence Mr R H Fowler prefers to obtain them by assigning 'weights' rather than probabilities, a method which leads to a more rigorous mathematical treatment As the immediate object is to treat statistical problems from the point of view of the classical quantum theory, this theory is regarded as fundamental, and classical systems are introduced as the limit, for large quantum numbers, of quantised systems This unusual procedure is justified by the remark that the laws of quantised systems cannot be obtained from those of classical systems The rules for assigning weights and the definition of normal properties as averages over the accessible phase space are of course the crux of the whole matter, they may even be looked upon as a postulation of the solution No attempt is made to disguise this logical hiatus, and it would seem that some such gap must always arise in the application of a mathematical theory to the physical world It is, indeed, an advantage that the crucial assumptions should not appear in a more subtle way

The rules for weighting are as follows

(i) To each element of phase space of a classical system is attached a weight proportional to its extension, namely,

$$(dp_1 \quad dq_s)/h^s$$

(ii) To each mechanically possible stationary state of a non degenerate quantised system is attached a weight unity

(iii) To each state of a degenerate system is attached a weight equal to the number of different stationary states of some non degenerate system which coalesce under adiabatic transformation in the limit to form the given state of the degenerate system

No general proof has been given that the weight of a degenerate system so defined is unique, nor is a general rule available for counting the non degenerate states This can scarcely be called a defect of the method, but is rather a limitation on our present state of knowledge These weights are adiabatic invariants in the sense of Boltzmann A simple example of an adiabatic invariant was given by Einstein in 1911, namely, the ratio of the mean kinetic energy of a simple pendulum to its period when the string of the pendulum is shortened infinitely slowly

Having arranged a system of weighting, the next step is to calculate average values This is done by constructing partition functions, which in the simplest cases are power series, the coefficients of which are the weights The average values are expressed as contour integrals involving these partition functions, and these integrals are then evalued by the method of steepest descents This is an extremely elegant and powerful mode of attack, and it is significant that the parameter ϑ which presents itself in the application of the

method can be interpreted as a function of the absolute temperature T, the actual relation being $\vartheta = e^{1/k}$, where k is Boltzmann's constant Gibbs considered assemblies of classical systems canonically distributed in phase, that is, those in which the index of probability is a linear function of the energy and containing a 'modulus of distribution' analogous to the temperature The partition functions are the generalisation for quantised systems of the phase integrals of Gibbs

After applying the above considerations to obtaining the statistical distribution laws of perfect gases, crystals, radiation, etc, the relation of thermodynamics to the equilibrium theory of statistical mechanics is established by showing that thermodynamical laws are true for the assemblies considered An extremely interesting and searching criticism is given of the method originated by Boltzmann and extended by Planck of introducing entropy by relating it to probability, a method which is claimed to be "obscure or misleading and certainly unnecessary" The author's argument is cogent and deserves to be read with care, but it is certainly surprising that the method has passed so long unchallenged

From this point the theory is developed in numerous aspects Nernst's Heat Theorem imperfect gases, thermionics stellar interiors, to mention a few of the topics treated Dr Lennard Jones has contributed an interesting numerical survey of intermolecular forces The author's object has been throughout to develop a consistent theory completely, and this object has certainly been achieved The bearing of the new mechanics has been summarised in the last chapter, the important result being found that the accessible phase space of the classical theory must be cut down to states appertaining to a selected group of wave functions

The leading comprehensive treatise in English on the statistical mechanics of an assembly of classical conservative dynamical systems is that of J W Gibbs, published in 1902 Since that date mechanical ideas have travelled far, and in the light of the new mechanics we have now to talk of a classical quantum theory Mr Fowler has written a worthy successor to the work of Gibbs, and it is to be hoped that, when the time is ripe, it will be followed by a treatise based entirely on the new mechanics Until that time arrives the present volume must remain the most authoritative source of information on the subject as a whole

L M MILNE THOMSON

Statistics in Biological Research

Statistical Methods for Research Workers By Dr R A Fisher (Biological Monographs and Manuals No 5) Second edition, revised and enlarged Pp xii + 269 (Edinburgh and London Oliver and Boyd, 1928) 15s net

WITH the increasing application of statistical methods to new fields of work, the problem of the handling of small samples has become more and more important It is true that the larger the sample the more trustworthy are the inferences which can be drawn from it, but there are certain problems, whether biological or industrial, in which the time and cost involved in obtaining even a moderately large sample would be quite prohibitive This need for a development of small sample theory has emphasised the importance of placing the methods of inference on a clearly defined and logical basis For loose thinking and careless interpretation are both easier and more dangerous when dealing with small than with large samples The aim of the statistician must be to bring the simplifying assumptions of theoretical analysis into correspondence with the varied and complex situations of practical work

Dr Fisher sets out in the introduction to this book, of which a second edition has been published recently, what may be termed his statistical philosophy It may not perhaps be easy to follow at a first reading—perhaps not before his mathematical papers published elsewhere have been read and if necessary interpreted in more familiar terms—but a grasp of the ideas involved is essential to a clear understanding of his methods These are perhaps, after all, more like those criticised than he will allow, but the line of approach is somewhat different His aim has been to develop on systematic lines a series of tests appropriate for use in a great variety of problems This has involved a very considerable extension of theory, based in several cases upon a most elegant use of the geometry of multiple space These proofs are not, of course, given in the present book, which is primarily intended for biological research workers, but the practical applications of the methods to a variety of problems are given with numerical illustrations, and the necessary probability tables

To discuss how far the author has achieved his object of putting clearly before the research worker the means of applying statistical tests, would require perhaps a reviewer who is a non mathematical biologist There is one criticism, however, which must be made from the statistical point of

view A large number of the tests developed are based upon the assumption that the population sampled is of 'normal' form That this is the case may be gathered from a very careful reading of the text, but the point is not sufficiently emphasised It does not appear reasonable to lay stress on the 'exactness' of tests, when no means whatever are given of appreciating how rapidly they become in exact as the population sampled diverges from normality That the tests, for example, connected with the analysis of variance are far more depend ent on normality than those involving 'Student's' z (or t) distribution is almost certain, but no clear indication of the need for caution in their applica tion is given to the worker It would seem wiser in the long run, even in a text book, to admit the incompleteness of theory in this direction, rather than risk giving the reader the impression that the solution of all his problems has been achieved The author's contributions to the development of 'normal' theory will stand by themselves, both for their direct practical value and as an important preliminary to the wider extension of theory, with out any suggestion of undue completeness

A last chapter on the principles of statistical estimation has been added to this edition It provides a good illustration of the application of the ideas contained in the introduction and else where, although perhaps it may prove stiff reading for the biologist

Our Bookshelf

The Works of Aristotle Translated into English under the Editorship of Dr W D Ross Vol 1 *Categoriæ and De Interpretatione*, by E M Edghill, *Analytica Priora*, by A J Jenkinson, *Analytica Posteriora*, by G R G Mure, *Topica and De Sophisticis Elenchis*, by W A Pickard Cambridge Pp iv + 652 (Oxford Clarendon Press, London Oxford University Press, 1928) 15*s* net

This substantial volume is the first of a series to be added to the well known Oxford translations, which is to include the whole of the extant works of Aristotle The six treatises of which this book consists constitute Aristotle's immense contribution to what became known later as the science of logic The translation faithfully reflects the nature of that contribution

One might gather from the statements made in many a compendium of the history of philosophy that Aristotle worked out a systematic treatment of logical science This is not the case All the same, he was the real founder of logic as a distinctive discipline, and it was he who made the wonderful discovery of the nature of syllogistic inference His work is set forth in this translation in a manner which will not only satisfy the scholar, but will also make it accessible to educated readers who cannot pretend to be scholars The four con tributors to the volume have worked under the general editorship of Dr W D Ross, whose guidance and inspiration each of them in turn gratefully acknowledges

The Statesman's Year Book Statistical and His torical Annual of the States of the World for the Year 1929 Edited by Dr M Epstein Sixty sixth Annual Publication Revised after Official Returns Pp xxxii + 1448 (London Macmillan and Co, Ltd, 1929) 20*s* net

This valuable year book has again undergone a thorough revision and incorporates the latest official statistics up to the time of going to press The lists of books of reference have also been revised Notable events have occurred in many States during the year, such as the establishment of a central government with new capital in China, the transformation of Albania from a republic to a monarchy, and the restoration of the temporal sovereignty of the Pope These and other events are duly noted, but the list of separate States now remains the same, and there have been few terri torial readjustments during the year The intro ductory tables include several of world production of selected commodities In one respect the value of the book could be enhanced that is by the inclusion year by year of more tables of this kind There is the usual section on the League of Nations The coloured maps show the City of the Vatican (on a large scale) and the Peru Colombia boundary adjustment The size of the book has been slightly reduced, mainly by the condensation of the index, which does not, however, impair its value

The Annual Register a Review of Public Events at Home and Abroad for the Year 1928 Edited by Dr M Epstein Pp xiv + 316 + 166 (London, New York and Toronto Longmans, Green and Co, Ltd, 1929) 30*s* net

This well known work of reference has now reached its hundred and seventieth volume, a length of life which alone expresses its value It continues on the lines of previous issues The first part, consisting of about 300 pages, is a survey of the history of the world during the year As usual, this survey is conspicuous for its completeness and lucidity Nothing of importance seems to be omitted In the second part of the book there are a chronicle of events which do not fall within the scope of the historical survey, and obituary of some hundred or more eminent men of all nations The retrospect of achievements during the year devotes nine pages to a record of science, which is little enough compared with literature and finance, but the scientific chapter is nevertheless an excellent survey of the year's progress The public documents given in full this year are the Kellogg Pact, the Convention of the Pan American Union, the Agree ment with Transjordania, and the Anglo Chinese Treaty

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications]*

New Evidence of the Action of Sunlight on Aurora Rays

ON Mar 15 last I received information from the State Telegraphic Department that earth currents were disturbing the telegraphic service Believing that we should have an aurora in the evening, I warned my four photographic stations, Oslo, Kongsberg, Tömte, and Oscarsborg, to be ready for action immediately after sunset Using the excellent type of direct vision spectroscope described by Lord Rayleigh,[1] I was able to localise an aurora arc in the northern sky during the twilight, long before it was possible to distinguish it visually

The photographic work began as soon as the sky had become dark enough, and a long series of photograms were taken simultaneously from two, three, or four stations during the whole night, among these are 14 quite successful ones from two stations, 38 from three stations, and 12 from four stations I led the work from my station Oslo, but was obliged to go home about midnight G M T Before going away I asked my excellent collaborators, Wesöe and Tveter, to continue until the dawn and keep a good look out for sunlit aurora rays, which might probably appear in the late hours of the night Their perseverance was richly rewarded At 2 h 40 m G M T, three hours before sunrise, there suddenly appeared in the north-east long bluish pale aurora rays which developed

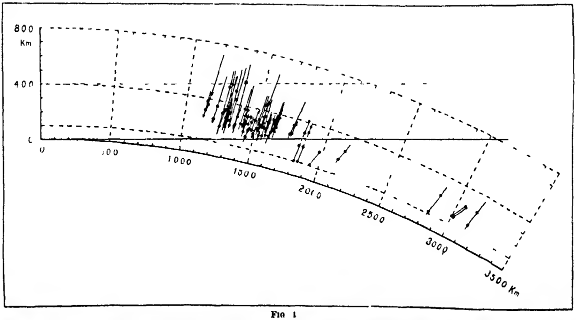
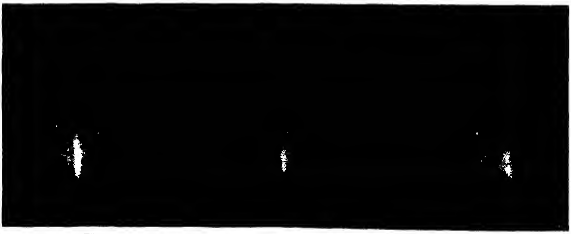


FIG 1



TÖMTE OSLO KONGSBERG

FIG 2 —Photographs of aurora taken simultaneously at the places indicated under them

[1] On Visual Observations of the Aurora Line in the Spectrum of the Sky at Night *Gerlands Beiträge zur Geophysik*, vol 19, pp 292 297

westwards and continued until 3 h 30 m G M T Meanwhile, at the station Oscarsborg, where Hafnor was working, the sky had become overcast, but the other three stations were now taking simultaneous photographs as fast as possible one after another, and a large number of successful photograms were secured At Oslo the photographs were taken by Tveter, at Kongsberg by Busengdal junior, and at Tomte by the Antarctic explorer Carsten Borch grevink

The measurement and calculation of those sunlit aurora rays have been made by my assistant Wesöe and myself and their position relatively to the earth's shadow calculated Also the other not sunlit aurora rays of the same night have been treated in the same manner

On the accompanying diagram (Fig 1) is seen the position of all the rays of the night of Mar 15–16 compared with the position of the earth's shadow The figure represents a vertical section of the earth, and the tangent to the earth's surface is the boundary between the sunlit and dark atmosphere For each point of an aurora ray the position in the vertical plane through the centre of the earth and the sun is marked by a small circle On each aurora ray two points are calculated and combined with a straight line representing the ray This line is continued beyond the points as far as the photographs indicate If the ray passes out of the photographic field it is marked by an arrow, and if the foot or summit can be seen on the photograph no arrow is given

FIG 3 —The rays as seen from Kongsberg Oslo and Tömte are marked by the letters K C and T Corresponding points have the same number

The high rays were all lying in sunshine, and their lowest points, which have been measured with great care, are situated near the boundary between sunlit and dark atmosphere Some of the rays have their summits nearly 700 kilometres above the earth, and all lie far to the north, some even in the zenith of Tromsö and northern Finland The measurements are particularly trustworthy on account of the long base lines, 46 68 km from Oslo to Tömte, 65 70 km from Oslo to Kongsberg, and 105 14 km from Kongsberg to Tömte The results have further been controlled by calculating the height in choosing either Oslo—Tömte, Oslo—Kongsberg, or Kongsberg—Tömte as base lines

In contrast to these high rays, lower rays are seen to the right on the same diagram, they lie in the dark part of the atmosphere Thus some of the same general features are seen here as on the diagram published in my communication to NATURE of Jan 19, 1929 A new and extremely interesting phenomenon was, however, observed with certainty on that night for the first time Some of the rays consisted of two luminous parts, one situated in sunlight and another in darkness and connected by an invisible part, stretching from the boundary of the sunlight and downwards These rays are indicated on Fig 1, the invisible part being dotted On Fig 2 are seen the photographs of the rays at 3 h 16 m 29s G M T

The constellation Auriga with the star Capella are clearly seen on the photographs A sketch of the situations of the principal ray is seen on Fig 3 On the right border we have chosen the corresponding points 1, 2, 3, 4, 5, 6, and with the different base lines the following heights were found in km

Base line	Point 1	Point 2	Point 3	Point 4	Point 5	Point 6
Oslo Tömte		161	202	314	363	
Oslo Kongsberg		151	211	323	368	
Kongsberg Tömte	100	157	214	316	361	409

The lowest point of the upper part was found to be at about 296 km and the highest point of the lower part to be at about 223 km above the earth's surface, calculating the height of the boundary between sunlit and dark atmosphere at the situation of the ray, we found it to be 275 km

Thus the bundle of corpuscular rays causing the aurora ray at first illuminates the upper sunlit atmosphere, then the illumination ceases at the beginning of the dark atmosphere but begins again lower down, when the density of the air is great enough to excite luminosity The action of sunlight may be a direct one, as mentioned in my former note, or an indirect one in forming a tail which becomes luminous where it is penetrated by the bundle of corpuscular rays

CARL STÖRMER

Oslo

A Property of Superconducting Metals

IN a recent article by Kapitza (*Proc Roy Soc* A, **123**, 342, 1929) it is suggested that (1) superconductivity is a general phenomenon, which can exist in all metals, but (2) is "masked by an additional resistance which does not disappear in most metals at low temperatures" This additional resistance is supposed to be due to "structural and chemical imperfections of the metal" Regarding (1), it appears that the superconductors have a peculiar hitherto unnoticed property, which will be presented in more detail below Because of this, I am inclined to believe that (1) is incorrect (to all practical purposes) and that one could with equal right say that ferromagnetism is capable of existing in all metals, but is masked by other effects in some As to (2), it would seem that, since the conductivity in the superconducting state is of an entirely different order of magnitude from that of the conductivity of any normal metal, the additional resistance disappears owing to the short circuiting, by the pure superconductor, of the impurity or structural imperfection In the system non superconductor + impurity, the two resistances are not of such greatly different orders of magnitude, and so the impurity may have a quite marked effect on the resistance

If one plots relative resistance against temperature, for the various metals (excluding bismuth), with the aid of the tables given by Onnes and Tuyn (*Comm*, Leyden, Supp No 58), then the curve is as follows (1) At low T, for non superconductors, approximately horizontal, with a finite intercept on the resistance axis, (2) at higher T, convex toward the temperature axis, and (3) at still higher T, linear in T over a large range of temperature In an analogous fashion to Kapitza's one can extrapolate the two linear parts (1) and (3) to intersection, and obtain a 'critical temperature' When one plots this critical temperature against atomic number, the curve resembles somewhat that of the plot of the Debye characteristic temperature Θ against atomic number, although the connexion, if any, subsisting between these two temperatures is by no means obvious The striking fact that is observed is that in the case of superconductors, including the newly discovered ones, tantalum and thorium, the critical temperature lies quite low, and probably lower than in the case of non superconductors That is, the temperature coefficient of

relative resistance for part (3) of the curve is more nearly $\frac{1}{3}$ for the superconductors than for the other metals. For the same part of the curve, at any given temperature, that metal is most likely to become a superconductor which has the greatest relative resistance. One cannot say that every superconductor has a low characteristic temperature, that of tantalum being at 243° K (F. Simon, *Zeits f. Phys. Chem.*, **129**, 334; 1927). No superconductor as yet discovered has, however, a high critical temperature, and this fact seems to be more than a chance coincidence.

A superconductivity model which gives a qualitative picture of most of the facts is easily set up. One may think of a crystal as composed of two systems interacting with each other, namely, (1) the lattice with its characteristic vibrations and (2) the electron system, considering the lattice ions at rest. In case (2), which includes electronic interaction, one may theoretically solve a Schrödinger equation and obtain eigenvalues and eigenfunctions. The system (1) may then be considered as a perturbation acting on (2). One can assume that in the superconducting state the lattice has not sufficient energy to impart it in the form of kinetic energy to the electrons, but that the latter may only change their magnetic energy. Probably, also there is no net exchange of momentum between electrons and lattice. There subsist then, no inelastic collisions and no elastic collisions with loss of momentum, so that no resistance can enter.

As to the influence of the magnetic field and its parallelism with that of the temperature, one can be guided by the Heisenberg picture of ferromagnetism. At $T=0$, in a vanishingly weak external magnetic field, the elementary magnets (electron spins) all point in the same direction. If energy is imparted to the system, either because of an external field being applied or the temperature being increased, then some spins will now be 'antiparallel'. It is assumed that the first excited kinetic energy level lies quite high for the superconductors, so that the magnetic energy cannot be converted into kinetic energy. This marks the essential difference between superconductivity and ferromagnetism, as in the latter case the kinetic energy levels lie so close together (probably) that magnetic energy may be converted readily into kinetic energy and the system will come to equilibrium when as many spins as possible are parallel (consistent with the temperature agitation), while in the former case such a balancing between spins and temperature agitation is not possible.

This picture is advanced only tentatively, to account for the sharpness of the transition temperature and the parallel effects of magnetic field and temperature. Whether it is right or not will only be known when it becomes possible to correlate, at least qualitatively, the value of the transition temperature with other properties of the metal, and to explain the connexion of superconductivity with the character of the resistance curve. JAMES H. BARTLETT, jun.

Zurich, April 27.

MR. BARTLETT brings up in his letter a very interesting view to explain the disappearance of the residual resistance at the threshold temperature in supraconductors. As this residual resistance is produced by impurities or structural imperfections, it is suggested that it can be short circuited by the perfect (healthy) paths of the conducting metal, which suddenly acquire an abnormally high conductivity of quite a different order from that observed in ordinary metals.

This picture, however attractive it is at first glance, presents some difficulty on comparison with experimental data. If we take, for example, the measurement by Meissner of the resistance (*Phys. Zeit.*, p. 725; 1926) of very good crystals of gold, cadmium, and zinc, in which the residual resistance is many times smaller than in ordinary wires, this makes it possible to estimate the value of the ideal resistance at a low temperature more accurately, and it appears that at 4.2° K the ideal resistance cannot be of a greater order than 10^{-6} of that observed at 273° K, and if we extrapolate the ideal resistance to 1.3° K, we find it to be less than 10^{-7} or 10^{-8}. Only the upper limit can be fixed from present experiments, and the actual ideal resistance may be any number of times smaller. This order for the upper limit of resistance corresponds to that fixed by present measurements for all supraconductors (except lead, where it was proved to be less than 10^{-12}). Thus there is no experimental evidence "that the supraconductive resistance is of any entirely different order" from the ideal resistance of a metal at a correspondingly low temperature.

According to Mr. Bartlett's view, this low ideal resistance of the healthy spot of the crystal must short circuit the bad spots which contribute the additional resistance even for non-supraconductors, and this does not agree with experimental evidence; for most of the metals the additional resistance remains practically constant in the range of the lowest temperature. On the other hand, McLellan, Niven, and Wilhelm (*Phil. Mag.*, p. 678; 1928) find that although 2 per cent of cadmium added to lead increases very much the residual resistance, the lead still remains a supraconductor. In this case it seems to me there is very little room left for the healthy undisturbed crystal lattice, as in a line of atoms, on an average, a cadmium atom will be separated by only 3 or 4 atoms of lead.

The sketch of the theory of Mr. Bartlett is very interesting, and it will be most important to see it worked out and tested by experiment. It seems to me that at present the greatest difficulty which meets any theory of supraconductivity is to account, not for the high value of the conductivity, but for the suddenness of the phenomenon. This is especially difficult, since the experiments definitely indicate that no structural or thermal phenomenon occurs at the threshold temperature, and I fail to see how Mr. Bartlett accounts in his theory for the suddenness of the appearance of supraconductivity. In any event it is evident that, according to his views, the mechanism of supraconductivity must take place in the healthy paths of the metal, and we must expect that the threshold temperature will be independent of the kind of impurity and a constant for any given supraconductor. This does not seem to be strictly the case; for example, in indium in different specimens the threshold temperature was found to be different (Tuyn and Kamerlingh Onnes, *Com.*, Leyden, No. 167*a*, p. 6).

On my view, which was supported by the evidence obtained in experiments on change of resistance in magnetic fields, the phenomenon of supraconductivity is accounted for by the sudden disappearance of the disturbances produced by imperfections in the metal which are the reason for the additional resistance. The advantage of this view is, first, that as the change must take place only in local spots in the metal, no change in the general state of the metal will be required, as actually observed (possibly, if the impurities amount to several per cent, such a change may be experimentally traced). Secondly, we should expect that the threshold temperature would vary with different impurities introduced in the metal. It is evident that on this suggestion it is practically inevitable that all metals at low temperatures will become supraconductors, if the influence of the impurity can be eliminated. I do

not think that there is any experimental evidence that the supraconducting metals form a separate group of elements like the ferromagnetic group or are exceptional in some other ways. We find the supraconducting metals in four groups of the periodic table. They have either a cubic or most irregular lattice; some of them belong to the transition group of elements, and we have amongst them the metals of the highest and lowest melting point. All the special relations between resistance and temperature for supraconductors pointed out by Mr. Bartlett are found by a more minute analysis of experimental data to apply also to some non-supraconductors. The special significance which Mr. Bartlett attaches without any theoretical justification to the fact that all supraconductors have a characteristic temperature below 243° K, probably is no more significant than the fact that the atomic weight of every supraconductor is higher than the 115 of indium, because this happens to be the lightest supraconductor.

Finally, the very important recent discovery made by de Haas (NATURE, Jan. 26, p. 130) that the eutectic alloy of gold and bismuth can become a supraconductor, must be considered very carefully. The details of the experiment are not yet known, but from the point of view which I am defending, the explanation of the phenomenon may be that in a mixture of gold and bismuth one of the metals absorbs more readily the impurities of the other, and this purification may be of such a nature that it allows one of the components to become a supraconductor.

All these considerations no doubt cannot be regarded as final proof of my suggestion, but they offer a definite application of the hypothesis and give a quite fresh experimental line of attacking the problem of supraconductivity.

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Mass and Size of Protein Molecules

By means of a method which utilises the measurement of sedimentation equilibrium and sedimentation velocity in strong centrifugal fields at constant temperature, a systematic study of the mass and size properties of the molecules of various proteins has been carried out in this laboratory during the last five years. Our work has been rewarded by the discovery of a most unexpected and striking general relationship between the mass of the molecules of different proteins and the mass of the molecules of the same protein at different acidities as well as of a relationship concerning the size and shape of the protein molecules.

It has been found that all stable native proteins so far studied can with regard to molecular mass be divided into two large groups: the hæmocyanins with molecular weights of the order of millions and all other proteins with molecular weights from about 35,000 to about 210,000. Of the group of the hæmocyanins only two representatives, the hæmocyanin from the blood of *Helix pomatia* with a spherical molecule of weight 5,000,000 and a radius of 12·0 $\mu\mu$, and the hæmocyanin from the blood of *Limulus polyphemus* with a non-spherical molecule of weight 2,000,000, have been studied so far.

The proteins with molecular weights ranging from about 35,000 to 210,000 can, with regard to molecular weight, be divided into four sub-groups. The molecular mass, size, and shape are about the same for all proteins within such a sub-group. The molecular masses characteristic of the three higher sub-groups are—as a first approximation—derived from the molecular mass of the first sub-group by multiplying by the integers *two, three*, and *six*. The molecules of the first and fourth sub-group are spherical, with a radius of 2·2 $\mu\mu$ and 4·0 $\mu\mu$ respectively, while the molecules of the second and third sub-group are non-spherical. Ovalbumin and Bence-Jones's protein belong to the first sub-group; hæmoglobin and serumalbumin belong to the second sub-group; serum globulin belongs to the third sub-group. Rhodophyceæ phycocyan, Cyanophyceæ phycocyan, Rhodophyceæ phycoerythrin, edestin, excelsin, amandin belong to the fourth sub-group in the neighbourhood of their isoelectric points.

The molecules of most of the proteins of the fourth sub-group are easily disaggregated with increasing pH. Thus R-phycocyan at a pH of 4·6 belongs to the fourth sub-group, but at a pH of 6·8 belongs to the third sub-group; that is, its molecules are disaggregated into halves and have lost their spherical symmetry. C-phycocyan at a pH of 4·6 belongs to the fourth sub-group, but at a pH of 6·8 about one-third of its molecules are disaggregated into halves, at the same time losing their spherical symmetry; at a pH of 12·0 the molecules of this protein are probably all reduced to the mass and shape of the protein molecules of the first sub-group, thus regaining their spherical symmetry. R-phycoerythrin at a pH of 4·6 belongs to the fourth sub-group, but at a pH of 11·0 about one-fourth of its molecules are reduced to the first sub-group. Edestin belongs to the fourth sub-group from its isoelectric point pH 5·5 to about pH 10. At a pH of 11·3 a considerable amount of molecules belonging to the second and third sub-group are present together with the normal molecules belonging to the fourth sub-group.

Although not more than 11 different proteins belonging to the group which displays these regularities have as yet been studied, it would seem very improbable that the relationship between the molecular masses and sizes were incidental. Perhaps the most striking proof of the close relations between the different proteins is the fact that one and the same protein may, according to the pH to which it is brought, appear with the molecular mass, size, and shape of another protein.

When looking for an explanation of these unexpected regularities, it would be well to bear in mind the fact already brought out by many bio-chemical experiences, namely, that Nature in the production of organic substance within the living cell seems to work only along a very limited number of main lines. The great variety appears in the specialisation of details. Thus it would seem that the numerous proteins are all built up according to some general plan which secures for them only a very limited number of different molecular masses and sizes when present in aqueous solution. By varying the constituents of the different proteins (different percentage of different amino acids, etc.) the chemical and electro-chemical properties may be varied sufficiently to enable the cells to make use of them for their different purposes.

The experimental data upon which the above conclusions are based have to a large extent been published in the *Journal of the American Chemical Society*. Part of the material is unpublished. The investigations have been carried out in co-operation with R. Fåhraeus, J. B. Nichols, N. B. Lewis, E. Chirnoaga, F. Heyroth, B. Sjögren, T. Katsurai, A. J. Stamm.

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Rate of Decay of Polonium in Different Points of the U S S R

THE half period of a radioactive element characterises the rapidity with which it decays If the classical theory of the spontaneously exploding atom be accepted this rate should be the same at any point of the earth's surface

In order to verify this assumption, measurements of the half period of polonium have been made during the past two years Polonium was chosen for this purpose, as the most convenient radioactive substance for observations of this kind, because it is easily obtained in a pure state, its half period can be directly observed ($136\ 5 \pm 0\ 3$ days), and it is also the last radioactive member of the uranium series

In these experiments polonium was deposited electrolytically on accurately polished gilt brass discs of 75 mm diameter to avoid the possibility of the oxidation of metallic surface Discs having small rims were supplied with round covers which safely protected the active layer from mechanical effects The process of carrying out the experiments was as follows The discs were carefully measured by means of a compensating electrometric set which allowed their activity to be determined through the magnitude of the ionisation current with an accuracy of 0 2 per cent The set itself was verified by means of a uranium standard Just after this measurement the active discs were packed, sealed up and sent by post to a number of places, where they were kept according to instructions in the Local Weights and Measures Offices which are under the management of the Central Chamber of Weights and Measures

After an interval of about five months, packets containing the discs were returned to Leningrad and were immediately measured for the second time The half period was calculated according to the formula expressing the rate of decay $I_t = I_0 e^{-\lambda t}$, and to the equation $T = \log 0\ 5 \times I/\lambda$ where I_0 is the initial activity before sending to the points I_t, the activity after the receipt in Leningrad, t, the time between two measurements, λ, the radioactive constant, and e the base of natural logarithms

The determinations of the half periods were made at eighteen points corresponding to eighteen towns, namely, Murmansk (1), Archangelsk (2), Leningrad (3), Vologda (4), Kazan (5), Moscow (6), Samara (7), Kursk (8), Saratov (9), Charkow (10), Rostow/Don (11), Odessa (12), Astrachan (13), Krasnodar (14), Wladikaukas (15) Tiflis (16), Baku (17), Erivan (18)

The most northern point was Murmansk (68° 59 N) and the most southern one was Erivan in Caucasus (40° 11 N)

All the points were distributed through a distance of 3000 km along the meridian The results obtained show that the rate of decay of polonium is far from being equal in all points The value of the period changed from 125 6 days (Tiflis) to 181 6 days (Krasnodar) A significant reduction for Astrachan gave the value 127 8 days The average least square error of the observations did not surpass 0 7 per cent

From the results obtained we reach the conclusion that, taking into consideration the absence of influence of the metal, which could only reduce the value of the half period, local conditions had an influence upon the rapidity of radioactive decay

To verify our assumption, the determinations of the half period were repeated for all eighteen discs after they had lain about five months in Leningrad The values of the period thus found varied from 137 2 to 139·5 days, which is not outside the limits of observation errors On the accompanying diagram (Fig 1) curve A shows the values of the half period in different places, and curve B the values of the half period in Leningrad

The experiments described are preliminary only, and the investigation will be undertaken on a larger scale with the view of determining without any doubt the influence of local conditions upon the rate of decay of radioactive elements

This phenomenon can be easily explained, if we admit Perrin's theory assumption of the existence of an external source of radiant energy which produces the radioactive decay of atoms If we admit the existence of this source in the centre of the earth,

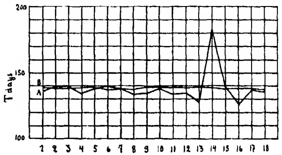

FIG 1

the rapidity of the decay must be influenced by the quantity of radioactive substance which is included in the great bulk of the basic rock The greater the quantity, the less must be the decay in this place because of the absorption of radiant energy, causing the radioactive decay of heavy atoms, by radioactive elements in the underlying layers

In favour of this assumption also, we have the fact that the greatest deviations of the period occur in places with disturbed tectonics, that is, in the places situated in Caucasus and the region adjoining it, on its northern boundary

L N BOGOJAVLENSKY

Central Chamber of Weights and Measures,
Leningrad, April 18

Thyroid and Temperature in Cold-blooded Vertebrates

THIS problem which Prof Huxley discusses in NATURE of May 11, p 712, is a very intriguing one To me it appears to have more difficulties than Prof Huxley allows for He begins by saying that "it is well known that the thyroid is concerned with temperature regulation in homothermic animals" In my recently published book, "Fever, Heat Regulation, Climate, and the Thyroid Adrenal Apparatus", I have reviewed the very scanty and contradictory literature on this subject, and one could scarcely say that the relationship of the thyroid gland to heat regulation has been previously either well known or well understood I dare scarcely hope that my own views on the problem as set forth in a book published only a year ago have already been assimilated so completely as to have become a commonplace of scientific literature

In the book mentioned I directed attention to the difficulties of the problem discussed by Prof Huxley In warm blooded animals a change of the thermal environment from heat to cold stimulates the thyroid and adrenal glands to increased activity, and there is a rise in general metabolism Exposure to heat produces the opposite effect it induces a resting condition in the thyroid and adrenal glands and the metabolism is lowered The resting condition of the

thyroid gland is indicated *inter alia* by an accumulation of colloid in the thyroid vesicles Now in cold blooded animals exposure to cold produces a fall both in the temperature of the tissues of the animal and in the metabolism, while heat raises both One might expect that a fall in the temperature of the animal as a whole would diminish the activity of its organs, including the thyroid gland In that case the interesting conclusion would follow that in the course of evolution the response to an environmental stimulus in a specific group of cells has been completely reversed although the cells have not changed their specific character

Prof Huxley's suggestion is that the thyroid of cold blooded animals, like that of warm blooded animals, is stimulated by cold and inhibited by heat This would imply that while the temperature of the animal as a whole falls and the activity of its organs diminishes, one particular organ—the thyroid gland—has a greater functional activity at a lower temperature than at a higher temperature One cannot exclude *a priori* such a possibility because it appears to be paradoxical But it requires more convincing evidence for its support than Prof Huxley adduces from his own experiments The statement attributed to Adler that in tadpoles low temperature caused hypertrophy of the thyroid gland both in growth and functional activity is open to the criticism that in warm blooded animals increased functional activity does not manifest itself by hypertrophy

In conclusion, it may be pointed out that the whole problem is further complicated by the fact that in warm blooded animals the adrenal gland plays a very important part in the heat regulating mechanism, this gland acting synergically with the thyroid gland There is a striking parallelism between the development of the heat regulating mechanism and the evolution of the adrenal gland as expressed in the changing anatomical relationship of the two histogenetically distinct tissues which in the mammals form cortex and medulla This must be taken into account when differences in the heat regulating mechanism of cold blooded animals is being discussed

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May 13

Variation of Latitude with the Moon's Position

IN NATURE of Jan 26, 1929, p 127, Prof H T Stetson has described a variation of latitude with the moon's position, and in the *Comptes rendus de l'Académie des Sciences* of July 30, 1928, A Gougenheim has described a variation of latitude with the

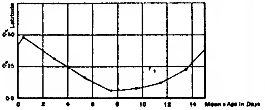

FIG 1

age of the moon In October and November 1926 a series of observations of the latitude of Dehra Dun (India, Lat. 30° N) were made with a prismatic astrolabe, which show a clear relation between the latitude and the age of the moon (Fig 1), but no relation at all between latitude and moon's altitude (Fig 2) The variation with the moon's age was about one third of that found at Algiers, and was apparently in phase with it

The fact that the astrolabe at Dehra Dun shows no variation with moon's altitude does not of course

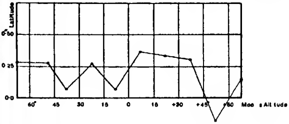

FIG 2

invalidate deductions made from Prof Stetson's more precise and extended series, but it seems surprising that the fortnightly variation (if it truly exists) should be larger and more easily measured than the daily variation

Each point in Fig 1 represents about 10 series of observations, each lasting about two hours and giving apparent probable errors of 0″ 3

G BOMFORD

Survey of India, Dehra Dun

A New Titanium Band System

THE dominant feature of the *M* type stars is the very extensive group of titanium oxide bands beginning in the blue region of the spectrum and continuing far to the red The group of bands occurring in the blue green region has been analysed (see Christy and Birge, NATURE, 122, 205 , 1928), and shown to be due to a $^3P - ^3P$ transition of neutral titanium oxide

Bands in the red portion have been observed by many investigators and especially by P W Merrill, who found that those of the λ7054 λ7700 region are particularly intense in *M* type spectra Twenty bands, including in all 46 heads, extending from λ7990 to λ6270, and partially overlapping the above group, have now been assigned to a new system The lower level is the same as that of the former system in the blue green This, and the fact that both systems appear in absorption in stellar spectra, show that the two are resonance systems The frequencies of the heads of the new system are given by

$$\left.\begin{matrix}14172\ 2\\ 14105\ 8\\ 14030\ 8\end{matrix}\right\} + (862\ 5n' - 3\ 84n'^2) - (1003\ 8n'' - 4\ 61n''^2)$$

with an average residual of 1 cm $^{-1}$ As shown by the formula, the mean separation of the heads is 70 7 cm $^{-1}$ The mean separation of the lower levels of the blue green system was shown indirectly to be about 70 cm $^{-1}$ (see *Phys Rev* , May 1929), indicating that the upper level of the new system is single Each of the three heads of the more intense bands has a clearly marked secondary head at about 10 cm $^{-1}$ to the red These latter heads are formed presumably by the *Q* branches Since transitions between singlets and triplets are very uncommon in band spectra, the upper level is in all probability a ^3S

The values of ω_0'' and $\omega_0''x''$ (that is, 1003 8 and 4 61) are believed to be somewhat more accurate than those published previously, and are based on the mean separation of levels as found from both systems Using the new values and assuming a linear extrapolation, the heat of dissociation for the lower level is found to be 6 74 volts The total energy resulting

from the dissociation at the other two levels is also about 7 volts There are still a few bands in the region λ6270 to λ5600, overlapping both systems, which remain unassigned Their general appearance is different from that of the bands in either analysed system

ANDREW CHRISTY
University of California,
April 22

Mimicry

THE objections to natural selection and chance variation raised by my friend Prof E W MacBride in NATURE of May 11, are those expressed by Asa Gray and answered by Darwin, when in 1867 he sent the advanced sheets of "Variation of Animals and Plants under Domestication" to the great American botanist The creative power of natural selection is explained by a metaphor

"If an architect were to rear a noble and commodious edifice, without the use of cut stone, by selecting from the fragments at the base of a precipice wedge formed stones for his arches, elongated stones for his lintels, and flat stones for his roof, we should admire his skill and regard him as the paramount power Now the fragments of stone, though indispensable to the architect, bear to the edifice built by him the same relation which the fluctuating variations of organic beings bear to the varied and admirable structures ultimately acquired by their modified descendants"

Now apply Prof MacBride's argument to Darwin's metaphor Why are certain stones selected ? Because they are the fittest" Certainly 'How do we know that they are the fittest ? Because they are selected" Obviously absurd

Again referring to 'chance' or 'accident', Darwin wrote 'The shape of the fragments of stone at the base of our precipice may be called accidental, but this is not strictly correct for the shape of each depends on a long sequence of events, all obeying natural laws But in regard to the use to which the fragments may be put their shape may be strictly said to be accidental"

With regard to birds as enemies of butterflies, the necessities of space prevent me from doing more than refer Prof MacBride to the publications of the Entomological Society of London, where he will find much evidence of serious attacks as well as numerous isolated examples

In reply to Dr Carter's interesting letter, I would point out that the behaviour of an insect eating animal may suggest processes essentially similar to the simpler reactions of man A chameleon once stung by a honey bee would never touch another The association and memory were perfect after a single lesson It must be remembered, too, that mimicry is especially characteristic of forest butterflies where the alternation of sunlight and shadow renders the imperfect resemblance of a flying insect far more effective than it would be in uniform light or shade

EDWARD B POULTON
Oxford, May 24

Another Species of Monœcious Oyster, *Ostrea plicata* Chemnitz

IT was noted by me in 1926 (*Proc Roy Phys Soc*, vol 21, Part 2, 1926) that the different species of *Ostrea* can be grouped into two categories, the monœcious and the diœcious I also enumerated several fundamental points of difference between them morphologically and physiologically Later in 1928, J H Orton in NATURE, Mar 3, 1928, put more emphasis upon the distinction of the two categories

There are more than sixty species of *Ostrea* distributed all over the world The greater part of them are diœcious, while the recorded species of the monœcious oyster are not many The first four species given below have already been recorded as having every character of a monœcious species

I here introduce one more species of the monœcious category which has not yet been recorded as such, namely, *O plicata* Chemnitz, or *O plicatula* Gmelin, the latter being probably the synonym of the former There are therefore five species now known to be monœcious *Ostrea*, as follow

O denselamellosa Lischke, the Japanese species
O edulis Linn, the European species
O lurida Carpenter, the British Columbian species
O angasi Sowerby, the Australian species
O plicata Chemnitz

The present species is found on the east coast of Japan It is by no means very rare, yet it has not attracted much attention of biologists or laymen, as its size is always rather small The species can attain sexual maturity in one full year, showing 'white sick' and 'black sick' stages, as is typical for the monœcious habit The size at maturity is only three centimetres in the longest diameter Even the largest specimen rarely attains more than six centimetres

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Television Inventions

IN NATURE of April 27, p 637, a notice appeared of a book by Mr C Francis Jenkins, of Dayton, Ohio, entitled 'Radiomovies Radiovision, Television" With some difficulty I have obtained a copy of this book from America, and find in it, in a picture which appears to be on page 74 (though no paging is given), a description copied from a journal of July 25, 1894, ascribing to C Francis Jenkins an apparatus for transmitting pictures by electricity, under the name of the Jenkins' Phantoscope This is identical in all essentials with the method of television proposed by G R Carey, an American, and dated 1875 according to "La Television Electrique", by A Dauvillier, published much later, in 1928, by *La Revue Generale de L'Electricite*, of Paris, while an illustrated description of Carey's method also appears in a copy I possess of *Design and Work* for June 25, 1880

These discrepancies in dates are worthy of notice, as is also the suggestion in "Television", by Alfred Dinsdale (editor of the *Television* magazine), published so recently as 1928, that Baird's transmitter was the first means by which real television was achieved, a means illustrated by apparatus at present on view in the Science Museum, South Kensington, in which the picture was formed piece by piece by passing light through staggered apertures in rapidly revolving discs, but which was, according to Dauvillier's very comprehensive survey of television inventions, actually patented by Nipkow, a German, so long ago as 1884, some forty two years before the arrangement was attributed to Mr J L Baird, that is to say, actually five years before Mr Baird appears, from "Who's Who", to have been born

A A CAMPBELL SWINTON
40 Chester Square,
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May 28

Down House and Darwin

DOWN HOUSE, the home of Darwin from 1842 to 1882, now vested in the British Association in custody for the nation, was formally dedicated to the public access on June 7 A distinguished company of members of the General Committee of the British Association, representatives of Darwin's family and of societies to which he belonged, and other invited guests, listened to the short ceremony at which Sir William Bragg, president of the Association, was in the chair, and Sir Arthur Keith was the principal spokesman

It will be remembered that Sir Arthur Keith, at the conclusion of his presidential address on the present position of Darwinism, at the Leeds Meeting of the Association in 1927, put forward a plea for the preservation of Down House This was promptly answered by Mr Buckston Browne, F R C S, who (in brief) bought the property, gave it to the Association with a generous endowment, has fully restored the whole house, and has brought back the ground floor as nearly as possible to its condition in Darwin's time, presenting many appropriate objects of art from his own collection Truly a noble benefaction, and one which imposes new and welcome duties upon an Association which should prove itself peculiarly fitted for discharging them The nearest parallel to them is found in the Association's action in 1842, when it saved Kew Observatory from being diverted from scientific use, and sustained the burden of its maintenance for thirty years Down House, however, will be no burden, but a very honourable trust

FIG 1 —Darwin's house at Down, Kent

Those whose minds find no appeal in the sentiment underlying the establishment of this memorial to one of the greatest of all leaders of research cannot be otherwise than an insignificant minority To the many it will mean more than a little to recapture, as they still may, the atmosphere in which Darwin, in the words of the inscription now erected beside his entrance gate, ' thought and worked for forty years " They may view the ' old study ' in which the " Origin of Species " was written, and others of his rooms, restored with much of his own furniture and articles of use, which have been sent back to their place by members of his family and other generous donors They may pass through his gardens (in the restoration of which the Association has no small task before it), they may follow him around the Sand Walk and still enjoy, as he did, the view across the pleasant valley towards the Sow Wood, as yet untouched by the builder or any other modernising influence save the gentle intrusion of a golf course, and here is indicated a further justification for the preservation of the property A pamphlet issued by the Association for distribution to visitors quotes a description of the neighbourhood as intensely rural and quiet though only sixteen miles from London Bridge ", and points out that Down still preserves these characteristics It may well be that in the future, as the outer circle of London extends, the preservation " of the estate ' will be regarded as an æsthetic blessing only less than as a dutiful tribute " to Darwin's memory

Behind these considerations, however — one fundamental, the other at least powerful—there arises the hope that the estate may be put to use for the direct benefit of science The attainment of such an object is present in the minds of the donor, of the members of the Down House Committee which the Association has appointed for the management of the property, and of others besides No plan has as yet taken definite shape , none could or should be given effect in a moment But it is not difficult to envisage more than one direction in which this idea—rather, this ideal—could be realised Meanwhile, when it is realised that the property was only vacated by the previous tenant six months ago, the condition of the property remarkably attests Mr Buckston Browne's generosity and enthusiasm A most distinguished American biologist has characterised his action as " initiating one of the most splendid movements of all time " An American committee has been appointed to co-operate with the Association's committee, especially in endeavouring to recover Darwiniana now in America There are those who look forward to Down as a scientific Stratford on Avon for future generations So may it be

The British Eclipse Expeditions of May 9, 1929

By Prof F J M STRATTON

BY the time these notes appear in print the facts on May 9 will be known of the eleven expeditions from France Germany Great Britain Holland Japan and the United States which are at present scattered on the line Sumatra—Kedah—Siam—Cambodia—the Philippines News can only be supplied here of the Japanese expedition under Prof Sotome to Titra in Kedah of the German expedition under Dr Rosenberg to Khoke Bhodi in Siam and of the two British expeditions to Alor Star in Kedah and to Pattani in Siam In all cases it can be said that preparations are well in hand attended so far by no serious delays or troublesome mischances

FIG 1 —British observers camp at Pattani

Shelters of atap palm in many cases supplemented by canvas or other linings to get the effect of a double roof cover the instruments preliminary adjustments are made and weather conditions do not seem likely unduly to hinder the final adjustments So far as can be gathered by comparison with present weather conditions prospects are most favourable at Pattani their Majesties the King and Queen of Siam are to visit the British camp there for the eclipse as in 1875 the then King of Siam observed the eclipse from Sir Arthur Schuster s camp

In Kedah the Resident Adviser to the Regent has done everything to facilitate the work of the expeditions Dr and Mrs Jackson are staying at the Residency and the eclipse camp is close by The necessary electric current required for Dr Carroll s comparison arc spectra and for the mercury lamp to be used by Dr Aston for the interferometer has been obtained from the town mains and through the kindness of the Regent all constructional work required has been done by the P W D Photographic troubles have been largely met by the kind permission of the medical authorities to make use of the dark room facilities at the local hospital

In Siam the conditions are much more difficult but the Siamese authorities have done everything possible to facilitate the work of the observers At each place the Government has erected a hut camp with mess room office kitchen six rooms and servants quarters lit by electric light All constructional material required and labour have been supplied arrangements made to guard the eclipse camps and to meet the requirements of the observers in the matter of electric current by the provision of portable electric plants His Majesty the King of Siam appointed a special reception committee charged with the duty of helping the astronomers in every way and right well have they carried out their allotted task All the local authorities in their turn have added to the obligations that the expeditions are under to the Siamese people Photographic difficulties are not

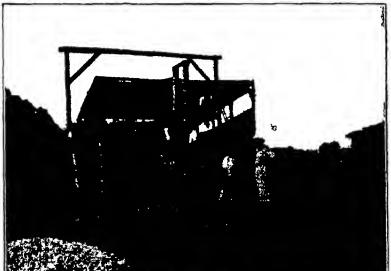

FIG 2 —Telescope in position at Pattani

insuperable, though real, in this hot climate A good deal can be done to meet them with ice from the local factory, and an efficient cooling plant, specially designed to meet the requirements of an eclipse dark room, should make matters still easier by providing a good supply of cooled water

Most of the personnel for the actual observations have already arrived, but special mention must be made here of the services to the British expeditions of their honorary secretary, Col J Waley Cohen Not only did he thoroughly explore both sides of the peninsula in 1928, bringing back valuable information as to meteorological conditions and as to local possibilities for eclipse preparations—and incidentally he interested many influential people in the coming eclipse—but he also arrived in the East this year ahead of the observers and made all the preparatory arrangements, so that a great deal was already done and in hand when they arrived At Pattani, Col Waley Cohen has also continued to relieve the scientists of the expedition of all worries about such matters as messing, local financial arrangements (not easy when there is no bank within many hours' journey of the camp), and the multitudinous details which have to be attended to, if matters are to go smoothly

The accompanying photographs, taken by Dr Royds, director of the Kodaikanal Observatory, show (Fig 1) the special camp erected for the observers to live in, and (Fig 2) the astrographic telescope from Greenwich in course of erection with Mr P J Melotte's instruments, including a coronagraph of 19 ft focal length with a direct vision prism for the first and second flash, three spectrographs, and a double tube camera with a Nicol prism in front of one object glass for a polariscopic study of the corona The party of the observers and assistants on the day of the eclipse will be twelve In addition to those above mentioned and myself, Prof F Barnes and W F Kibble, of Madras, have already been at the camp for some days and given valuable help

Einstein's and other Unitary Field Theories An Explanation for the General Reader

By Prof H T H PIAGGIO

II

GEOMETRY ON A SPHERE

THE leading ideas of the geometry that Einstein chose (Riemannian) can be made clear by considering the properties of a geographical globe (Fig 1) on which are marked the meridians and parallels of latitude These divide the surface into what we may call curvilinear rectangles But these rectangles are not all of the same size or shape For consider two points with the same latitude but with longitudes differing by one degree The distance between them depends upon the latitude, it is greatest at the equator and zero at the poles Thus APB is greater than DQC For a sphere the distance between two points with the same longitude (i e on the same meridian), but with latitudes differing by one degree, is constant, but if our globe (like the earth itself) is flattened at the poles, this distance will again depend upon the latitude

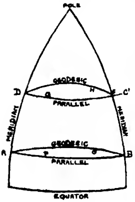

FIG 1

In either case, we cannot find the distance between two points A and C on the globe merely by knowing the *differences* of their latitudes and their longitudes, whereas in a plane the distance between two points is determined solely by a knowledge of the differences of their x and of their y co ordinates This is what is meant by the rather alarming statement that the sphere has a Riemannian metric, while the plane has a Euclidean one (In mathematical symbols, $ds^2 = dx^2 + dy^2$ shows a Euclidean metric, but $ds^2 = g_{11}dx^2 + g_{22}dy^2$ shows a Riemannian metric, provided that g_{11} and g_{22} are functions of x and y, or of either of them)

It is not only a plane that has a Euclidean metric Take a piece of squared paper, and roll it up, or bend it (without stretching or tearing) into as queer a shape as you please The squares drawn on it remain all of the same size as before, hence the metric is still Euclidean Such a surface is said to have zero *Gaussian curvature*, although it is what an ordinary person would call curved The real distinction between it and a sphere is that the squared paper can be flattened out again, whereas it is impossible to flatten out a sphere or a piece of it (as may be easily verified with a piece of a broken rubber ball) Another way of putting this is to say that any attempt to make a flat map of the earth must be imperfect and give a distorted representation, as is obvious on Mercator's chart near the poles

A well known problem in geography or navigation is to determine the shortest route that can be traversed between two points on the earth's surface On a model globe we can determine this experimentally by stretching a piece of string between these two points It will be found that it will lie in what is called a *Great Circle*, namely, one the plane of which passes through the centre of the earth It is important to notice that it is not the same as a parallel of latitude In fact a ship that has to sail between two points A and B on the same parallel APB (north of the equator) will, to follow the Great Circle AGB, have to sail north of this parallel and then come back to it, a method rather tiresome to navigators, as it entails a continual change of direction (as measured by compass bearing) A Great Circle on a sphere has one of the properties of a straight line in a plane, namely, that of being a *geodesic* or shortest distance between

two points on it but not (in general) another that of having a constant direction This may be considered to belong to a route that makes a constant angle with the meridians it is called by navigators a *rhumb line* or *loxodrome* They often use it in spite of it not being a geodesic because it preserves a constant compass bearing which can be determined at once by drawing a straight line between the two positions as marked on Mercator's chart It is important to notice that what we here call constant direction on a sphere is defined by reference to compass bearing or Pole star or axis of rotation (through which the meridians pass) each of which is really quite independent of the geometry of the sphere itself and to that extent is arbitrary

GEOMETRICAL BASIS OF EINSTEIN'S GENERAL THEORY

Einstein's General Theory may now be stated broadly as the assumption that the physical geometry of space time is one which has a Riemannian metric and a curvature and in fact is somewhat analogous to geometry on a sphere The analogy is made closer if we replace the sphere by a surface like a hen's egg of which the curvature is variable If the egg has been hard boiled and then deprived of its shell so as to be flexible the analogy is still further improved for the Gaussian curvature and Riemannian metric which depend only on a network of curves drawn on the surface and deformable with it are the properties with which Einstein is concerned It is important to notice that no account is taken of any measurements except those made *on* the surface which from this point of view is a two dimensional region

The non mathematical reader may however say How can two dimensional results on a sphere or egg which everyone can imagine be applicable to four dimensions which are inconceivable? The answer to this is that the symbols used by mathematicians have the valuable property that they enable us to work largely by analogy in four dimensions almost as easily as in two The merit of Riemannian geometry which to those unfamiliar with it may appear rather complicated is that in it the physical laws of the motion of a planet or of a ray of light are the simplest possible namely that they are geodesics By stipulating that the paths must be very nearly those given by Newton's law of gravitation we get some indication of how to determine the coefficients in the Riemannian metric To determine these fully requires other considerations too lengthy to enter into here

As is now well known this theory has been strikingly successful not only in explaining a known fact the anomalous motion of the perihelion of the planet Mercury but also in predicting successfully the effect of a strong gravitational field on the bending of light and the shift of spectral lines Eclipse expeditions speedily confirmed the first prediction but the second was originally denied by experimenters The spectral shift is now admitted to exist and the minute effects due to the sun have been supplemented by the more easily observed effects due to the dark star of enormous density called the Companion of Sirius

PHYSICAL BASIS OF THE UNITARY FIELD THEORIES OF WEYL EDDINGTON AND EINSTEIN

We have seen that the Special Relativity theory is fundamentally an electromagnetic one while the General Theory is fundamentally gravitational After constructing a geometry of space time specially chosen so as to explain gravitation in a simple manner Einstein found that electromagnetism could be fitted into the scheme but could just as well be left out Now this is scarcely satisfactory Gravitation and electromagnetism are both physical phenomena and why should one be considered as an essential property of space and the other as only an accident? Was the world constructed solely for the requirements of gravitation and then part of it let off to electromagnetism as a lodger? The obvious thing seemed to be to modify the Riemannian geometry so that it would serve gravitation and electromagnetism equally well

GEOMETRICAL BASIS OF WEYL'S UNITARY THEORY (1918)

Einstein had made gravitation appear as a natural consequence of replacing Euclidean geometry by Riemannian in which the geodesics lose their property of preserving a fixed direction Weyl proposed to replace Riemannian geometry by another in which the idea of length is also given up In his theory at any rate in its original form the length of a rod altered every time it passed round an electric current This theory certainly gave some interesting mathematics in which equations of the form of Maxwell's electromagnetic ones made their appearance but as it has received no experimental confirmation whatever it need not be considered very seriously

EDDINGTON'S UNITARY THEORY (1921) AS A GRAPH

Weyl's geometry formless as it seemed still retained one definite property of which Eddington promptly proceeded to divest it We shall not enter into details because Eddington avowedly is not claiming to construct a physical theory but only an illustration or graph which may be looked upon as a device useful in enabling us to grasp certain mathematical relations He hoped it might throw light on the nature of the forces which prevent an electron from exploding but up to the present it does not seem to have done so

Eddington considers that not only his own unitary theory but also Weyl's and Einstein's are graphs However from Einstein's own words— my opinion is that our space time continuum has a structure of the kind here outlined —it would appear that it is claimed to be a genuine physical theory

EINSTEIN'S UNITARY THEORY (1928–29)

Whereas Weyl and Eddington replaced Riemannian geometry by others still more unlike Euclidean, Einstein has now, in part, returned to more ordinary ideas His geometry is one which possesses *distant parallelism* as well as a Riemannian metric To explain what is meant by distant parallelism, we return to our two dimensional analogy Cover our hen's egg, or any other surface, with a network of curvilinear rectangles' 'Parallel directions' are defined as those which make the same angles with corresponding sides of the local rectangles This definition leaves the original choice of the network undefined, but we saw that on a sphere direction had to be defined by some thing, like a magnetic compass or a pole star, which was not a property of the sphere itself, and so in a certain sense undefined by its geometry alone

Perhaps Einstein's parallel directions may be ultimately defined in terms of dynamics He may even get back to the position of Newton, who conceived absolute rotation to be a real thing, which could be detected by seeing whether the surface of a fluid was a paraboloid of revolution or a plane The behaviour of Foucault's pendulum and of gyroscopes certainly seem to furnish us with a dynamical definition of direction

By using our sphere, we may even give some idea of the actual function that Einstein takes to measure what may be called electromagnetic potential Suppose a boat has two short trips, each of one mile, one east and the other north By sailing first one mile east and then one mile north, let us reach a point C By sailing first north and then east we reach a different point C′, since the parallels of latitude get smaller as we go north (see Fig 1). The distance CC′ represents Einstein's potential This illustration is not exact, because on a sphere CC′ is very small compared with the distances AB, BC, whereas in Einstein's theory it is essential that it should not be so To illustrate this we should have to suppose our sphere to have a crinkly surface

If we now take the corresponding construction for three dimensions, the result is rather queer If AB and DC are parallel' paths, the path from B 'parallel' to AD will not intersect DC It is properties of this kind that Eddington finds unattractive, but they are essential to the electromagnetic part of the theory

Of course the ultimate test of the theory must be by experiment It may succeed in predicting some interaction between gravitation and electromagnetism which can be confirmed by observation On the other hand, it may be only a 'graph' and so outside the ken of the ordinary physicist Einstein's paper points out that so far there has not been time to examine the full consequence of his equations

Even supposing the theory fully established, there are still fresh worlds for Einstein to conquer The quantum theory remains outside his scheme He made an attempt to deal with this so far back as 1923, but without any striking success However, it has been suggested that the postulate of distant parallelism will enable the unitary theory to take over Dirac's theory of a spinning electron almost unchanged

The Detection of Helium

THE natural facility with which the radioactive elements disintegrate has led on one hand to attempts to break down atoms artificially, and on the other to build them up from simpler particles Rutherford succeeded in conveying the necessary energy to some of the less massive atoms and broke them down by bombardment with sufficiently energetic α rays, atom by atom at comparatively rare intervals the process of atom building is still not more than a dream, realised perhaps in the depths of space as Millikan has suggested in order to account for cosmic rays

The production of gold from mercury, and many another attempted transmutation, have proved, to put it mildly, apparent rather than real changes In the case of the experiments in which helium was supposedly formed in some way or another by an electric discharge, there has lurked for a long while a certain feeling of unsatisfactoriness Prof Paneth's recent work goes far to dispel this feeling (see *Zeits f phys Chem*, **134**, 353, 1928, and **1**, 170 and 253, 1928) The outcome is indeed satisfactory those that found helium have reason to have got it, those that did not might well have found it, and been misled perhaps as to its origin

Paneth and Peters show that helium is the only gas which at ordinary temperatures can diffuse through glass At a pressure of 0 5 atmosphere 10^{11} c c of helium will pass through a thickness of 0 5 mm of soda glass per cm ^{2} per hour The amount of helium that gets through from the air at ordinary pressure into an evacuated glass vessel (1 mm wall thickness) is 10^5 times less, so that a glass apparatus is for all practical purposes 'tight' at ordinary temperatures When warm the rate of diffusion through the glass is much greater (cf Lo Surdo, *Atti R Accad Lincei*, **30**, 1, 85, 1921) A hard glass tube 1 5 mm thick at 500° C lets through 10^{9} c c of helium from the air per cm ^{2} per hour Helium, indeed, can be separated from neon and other gases by diffusion through hot glass It is otherwise with palladium Helium will not diffuse through palladium at a red heat A mixture of helium and hydrogen can be separated completely by diffusion of the hydrogen through a palladium capillary, the quantity of helium that gets through is not even 10^{12} of the quantity of hydrogen that passes Helium and neon are found in the gases absorbed by glass which has been in contact with air, but the gas is considerably richer in helium than in neon On the other hand, if there is a minute flaw in the glass or at a tap, causing a leak however small, the neon and helium found in the residual gases remain in the same proportion as

they exist in the air approximately 3 1 (It is noteworthy that Paneth and Peters found that good taps could be relied on not to leak if properly ground and greased their apparatus was therefore not made tap free Twenty taps standing 48 hours had not leaked to the extent of more than 10^{6} c c air equivalent to about 10^{10} c c Ne and He) It can be shown that a vacuum tube which becomes heated by a discharge will contain afterwards traces of helium if it is not protected from access of air externally however great other precautions may have been taken to prevent ingress of air A double wall is not even sufficient if both become warm It is necessary to immerse the tube in water or in oil which cools and at the same time seals the glass The presence or absence of helium in the residual gases is therefore mainly a question of the temperature of the walls of the tube and the sensitiveness of the method of detection

Paneth gives 10^{12} to 10^{11} c c as the limiting volume of helium which can be detected spectroscopically This means that in his apparatus the helium and the neon in about 10^{5} c c of air can be detected—a limit about 100 times smaller than that given for the method used by Strutt (*Proc Roy Soc* A **89**, 499 1914) A careful study is made of the quantity of gas required to bring out the various spectral lines for the pure gases neon and helium and their 3 1 mixture obtained from atmospheric air The spectra of the gases are examined using a capillary tube about 0 1 mm bore the fine capillary makes it unnecessary to use a slit with the spectroscope Excitation is provided by external electrodes The results enabled estimation of very minute quantities of the gases to be made without recourse to uncertain volume measurements in fine capillary tubes For quantities at the limit of detection (10^{10} c c) only the 5875 and 5015 lines of helium are visible and only the 5852 line of neon The latter masks the 5875 helium lines in a mixture of the two gases and only 5015 remains visible Paneth succeeded in this way in measuring the quantities of helium (about 10^{8} c c) generated by only about 40 grams of thorium in 113 days taking very special precautions to prevent contamination with helium from other sources Even with every precaution a trace of neon was also detectable

Either calcium or an electrically heated spiral of palladium were employed for removing large quantities of hydrogen from the gases under examination for smaller quantities combustion with oxygen at the surface of palladium sponge was used The gases were taken from place to place along with oxygen which was afterwards removed by absorption with cooled charcoal the residual rare gases being run up into the capillary tube for the spectroscopic test Special precautions were taken to prevent any rare gases being present in the electrolytically generated hydrogen and oxygen used throughout the work these latter were shown to contain less than about a millionth of a per cent of air All parts of the apparatus with large glass surfaces and those subjected to heat were vacuum jacketted and then immersed in water

Paneth and Peters have bombarded salts of potassium they have run a heavy discharge through hydrogen between aluminium electrodes at pressures from 1 to 85 mm and also between a palladium spiral electrode through which a large quantity of hydrogen was diffused without obtaining any helium or neon other than traces from ascertained sources They have tried a powerful silent discharge through hydrogen at 10 to 760 mm pressure and they have passed a heavy discharge through paraffin examining the hydrogen so generated In all cases the results were negative provided the glass was protected from transfusion by helium from the air In spite of the stability of helium and the possibility of building it up from protons and electrons with evolution of 7×10^{11} cals per mol these experiments show that even with a favourable high concentration of hydrogen the amount of helium so formed is certainly less than 10^{9} c c The same result applies to the production of helium by bombardment of water and of mercury with β and γ rays To these experiences have to be added those of Allison and Harkins (*J A C S* **46** 814 1924) in which very heavy discharges were employed yet with no positive effects Considering too that the sensitiveness of detection in Paneth and Peters work is claimed to be 10^{4} times greater than the volumes of helium and neon obtained in those experiments by other workers which have appeared to give positive results (*e g* production of helium from salts of potassium where the quantity found was between 10^{5} and 10^{6} c c) it is fairly definite that their source must be other than permitted by Paneth s arrangements and precautions

One of these sources when helium is alone found is no doubt the diffusion of helium through heated glass (or quartz) It is interesting to note that this was also the conclusion of Masson in his experiments with the quartz mercury arc (*Proc Roy Soc* **91** 30 1915) It is noteworthy that Paneth found that glass which is exposed to air contains helium and less neon (50 cm^{2} of glass holds more than 10^{8} c c He) Hydrogen greatly assists the removal of these adsorbed gases Oxygen however, has practically no effect in washing them out of the glass Heating alone without washing with hydrogen is also comparatively ineffective This fact seems also to explain some features of the earlier work Prof Paneth s work has gone a long way to clear up the unsatisfactory state in which this subject had been left There is now no evidence for the formation of the rare gases by the discharge, but very definite reasons for their detection in the kind of experiments which were carried out (*e g* presence of He in X ray tubes as found by Ramsay (NATURE **89** 502 1912))

Passing from experimental work of a critical nature to that with a more constructive object, Paneth has utilised his methods of detection of minute quantities of helium in connexion with a variety of other problems (see *Zeit anorg Chem*, **175** 383 1928, and *Zeit f Elektrochem*, **34** 645, 1928) Amongst them may be mentioned the origin of the abnormal helium content of sylvin and beryl,

the quantity and origin of helium in gases of natural origin and the helium content and age of meteorites At Ahlen in Westphalia a source of natural gas has been found to provide about 40 m^3 per day containing 0 19 per cent helium but this does not compare with the source at Calgary in Canada 330 000 m^3 per day containing 0 33 per cent He or with that at Petiola in Texas 425 000 m^3 per day of 0 9 per cent The ages of the various iron meteorites investigated are found to range from that of the Savic meteorite (8000 years perhaps) to the hoariness of the Nelson Co meteorite comparable to the age of the earth ($2 6 \times 10^9$ years) It is thought that passage near the sun might account for the removal of helium from the Savik meteorite making it appear more youthful than it is really likely to be

Another interesting direction of Prof Paneth s work was in the attempt to prepare helides after the manner in which he has so successfully made hydrides of various elements No trace of the formation of helides of arsenic antimony lead germanium selenium iodine and chlorine was obtained In the experiment with chlorine the merest trace of the formation of a helide would have been detectable It is considered that such helides as can be formed can only have a very fugitive existence of the order of 10^{-8} second

One might recall the words of Leonardo da Vinci in connexion with all this illuminating work Experience is never at fault it is only our judgement that is in error in promising itself such results from experience as are not caused by our experiments A C F

Obituary

George Birtwistle

GEORGE BIRTWISTLE was born at Burnley in 1877 Educated at Burnley Grammar School and Owens College he won an open scholarship in mathematics at Pembroke College Cambridge in 1895 He was bracketted Senior Wrangler in 1899 and was placed in Class I Division I of the post graduate part of the Mathematical Tripos in the following year He was immediately elected to a fellowship and was responsible for the mathematical teaching in Pembroke until the time of his death He had also served as assistant tutor and prætector of the college He died very suddenly and unexpectedly on May 19

It was as a teacher rather than as an investigator that Birtwistle was known and as a teacher that he played a conspicuous part in Cambridge mathematics especially during the last ten years In certain respects his position was unique for he was a link between the older theoretical physics and the new Since the War while continuing to lecture on classical mechanics electrodynamics and hydrodynamics his interest in more recent developments always strong rapidly increased He began to lecture on the older quantum theory on thermodynamics (then just introduced into the schedule of elementary teaching) and finally on modern quantum mechanics Each of these lecture courses ultimately grew into a book

As a lecturer Birtwistle was admirably clear and easy to follow He set, in fact, a standard of exposition which made it very difficult for anyone to attract students to any duplicate course His books are like his lectures—admirable expositions of those sections of the subject with which he deals, written in lecture room style He seldom attempts to go deeply into difficult points or to present the subject as a single logical whole His aim is the lecturer s aim—to interest the student in the subject, especially in its more outstanding or exciting parts, and lead him on to other more systematic or abstruse expositions

In all his lectures and in all three books, Birtwistle was successful in this aim, though naturally in varying degrees Perhaps the least successful of his books was the last on modern quantum mechanics Here owing to the novelty of the subject and the absence (when Birtwistle wrote) of other more systematic expositions (or indeed of any other exposition) the weakness of his deliberate method becomes more obvious The book gives rather the impression of a collection of interesting isolated sketches It stimulates the reader to ask for more but to what other author is he to turn? With the coming of other books the weakness is already less felt and Birtwistle s book is gaining in value as a stimulating introduction The staff of the Mathematical Faculty of Cambridge mourn the untimely loss of a valued friend and colleague

Dr W Martin

DR WILLIAM MARTIN who died on May 24 was known to a very wide circle as an antiquary whose knowledge and insight enabled him to see almost everywhere in London vestiges of the life and activities of former times but to many others he was known as an authoritative exponent of patent law and he was an occasional contributor to our columns upon this subject

Dr Martin s antiquarian bent led him to treat patent law historically but he was none the less alive to the conceptions which govern modern practice in this sphere In his lectures and publications notably his articles in the *Law Quarterly Review* he worked out with great originality a systematic key to the immense body of decided cases with which he seemed to be familiar in every part The law of treasure trove also attracted him and in it he saw contrary to the opinions of some antiquaries means which could be utilised for the advantage of archæology as a check on the surreptitious disappearance into private collections of finds of general interest

As an antiquary Dr Martin was insistent on a strict separation of ascertained fact from the accretions of sentiment and fancy which too often obscure instead of illuminating the past Nowhere was he more impatient of any looseness than in his

treatment of Shakspeniana He was an acknowledged authority on Shakspeare, and was proud of the part he took as president of the Shakspeare Reading Society in placing in Park Street, near Bankside, the handsome bronze memorial which now marks the site of the 'Globe'

Dr Martin was a graceful writer, clear and entertaining as a lecturer, and an ideal guide, with a very practical gift for organising which enabled him to carry through his arrangements strictly to time Perhaps he found his greatest happiness in conducting parties through almost forgotten alleys and byeways of London which he loved, and filling them from his stores of knowledge with pictures of the life of other days Many are those who have enjoyed afternoons spent with him on these rambles who will still find pleasure in the remembrance of his easy discourse and the charm of his personality He was keenly interested in many aspects of natural history, as well as being an authority upon archæological subjects and he served as president of the South Eastern Union of Scientific Societies It was particularly appropriate that Dr Martin should be elected the first president of the Gilbert White Fellowship, the object of which is "To continue the work of Gilbert White in the study of natural history and antiquities" He took an active part in the meetings and excursions of this Fellowship within a few days of the illness which resulted in his regretted death

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WE regret to announce the following deaths

Prof Thomas W Cave, vice principal of the South Eastern Agricultural College, Wye, and for twenty seven years head of the Veterinary Department of the College, on April 25, aged seventy years

Mr A H Cheatle, C B E, the distinguished aural surgeon, who presented to the Royal College of Surgeons his valuable collection of preparations illustrating the anatomy of the mastoid region, on May 11, aged sixty two years

Prof Peter Gillespie, professor of civil engineering, University of Toronto at fifty six years of age

Commendatore Rodolfo Lanciani, K C V O, Senator of the Kingdom of Italy and formerly professor of Roman topography in the University of Rome, on May 21, aged eighty three years

Dr James Moir, a past president of the Chemical, Metallurgical and Mining Society of South Africa and of the Chemical Section of the South African Association for the Advancement of Science, on Mar 31

Mr O A Reade, pharmaceutical chemist, president of the Lowestoft and District Literary and Scientific Association, and author of a flora of the Bermudas, on April 14

News and Views

THE King's Birthday honours list includes the names of the following scientific workers and others associated with scientific activities *Baron* Sir Edward Allen Brotherton, chemical manufacturer *Privy Councillor* Lord Dawson of Penn, Physician in Ordinary to the King *Baronets* Sir E F Buzzard, Physician Extraordinary to the King, Sir Hugh Mallinson Rigby, Sergeant Surgeon to the King *Knights* Prof H C H Carpenter, professor of metallurgy in the Royal School of Mines, Imperial College of Science and Technology, Mr J J Ralph Jackson, Chief Veterinary Officer, Ministry of Agriculture and Fisheries, Mr W S Jarratt, Comptroller General of the Patent Office, Prof W C MacKenzie, Director, and professor of comparative anatomy, National Museum of Australian Zoology, Dr Peter Chalmers Mitchell, Secretary of the Zoological Society of London, Prof C V Raman, Palit professor of physics in the University of Calcutta, Brigadier E A Tandy, Surveyor General of India (retired), Dr R S Woods, Honorary Physician and Honorary Surgeon, London Hospital *K C B* Sir F S Hewett, Surgeon Apothecary to the King *C B* Major General H P W Barrow, Director of Hygiene, War Office *C S I* Mr James Herman Field, late Director General of Observatories, India *G C M G* Sir John Cadman, emeritus professor of mining, University of Birmingham *C M G* Dr L Cockayne, in respect of honorary scientific services to the Government of the Dominion of New Zealand, Mr O F H Atkey, Director of the Sudan Medical Service *G C V O* Sir Humphry Rolleston, Physician-in-Ordinary to the King *C V O* Dr L E H Whitby, bacteriologist *M V O* Prof E C Dodds, professor of bio chemistry at Middlesex Hospital *C I S O* Mr W A Baker, lately Surveyor General, Jamaica, Mr J F Halpin, Superintending Chemist, Government Chemist's Department *G B E* Prof Dame Helen Gwynne Vaughan, professor of botany in the University of London, Sir Arthur McDougall Duckham, Director General of Aircraft Production *K B E* Major General T H Symons, Honorary Surgeon to the King, Director General, Indian Medical Service *C B E* Mr P N H Jones, Director of Public Works, Bermuda, Lieut Col F J McCall, Director of Veterinary Services, Tanganyika Territory, Capt R S Rattray, for services as Government Anthropologist in the Gold Coast and to aviation in West Africa, Col A H Safford, Assistant Director of Medical Services, Baluchistan District, India, Mr Nicholas White, Chief Engineer, and Secretary to the Government of the Punjab, Irrigation Branch *O B E* Mr H Brown, Principal Officer, Plant and Animal Products Department, Imperial Institute, Major D G Cheyne, Deputy Assistant Director of Hygiene, China Command, Dr F Dixey, Director of the Geological Survey, Nyasaland Protectorate, Major J N Duggan, professor of ophthalmic medicine and surgery, Grant Medical College, Bombay, Mr J C F Fryer, Director, Ministry of Agriculture and Fisheries Pathological Laboratory, Harpenden, Lieut Col F J M Stratton, professor of astrophysics in the University of Cambridge, Mr G Stuart, Assistant Director, Laboratories, Department of Health, Palestine *M B E* Mr E W Davy, Assistant Director of Agriculture, Nyasaland Protectorate

THE Lords Commissioners of H M Treasury have appointed a committee to inquire into matters affecting the functions and staff of certain Research and Experimental Establishments of Government Departments, with the following terms of reference To examine the functions and organisation of the undermentioned Establishments in the Government Service and to report on the method of recruitment and conditions of service of the civilian scientific and technical officers employed therein (*a*) The Research and Experimental Establishments under the Admiralty, War Office Air Ministry, and Department of Scientific and Industrial Research (*b*) the Department of the Government Chemist and the Establishments under the Admiralty and War Office concerned with chemical analyses, and (*c*) the Meteorological Office

THE chairman of the committee is Prof H C H Carpenter, professor of metallurgy, Royal School of Mines, and the members are Sir W J Larke, the director of the National Federation of Iron and Steel Manufacturers, Sir Robert Robertson, government chemist Mr F M Morris, the assistant secretary at the Treasury in charge of staff questions affecting the Defence Departments Mr R J G C Paterson, one of the directors of finance at the War Office Dr F F Smith, director of scientific research, Admiralty, Mr H T Tizard secretary of the Department of Scientific and Industrial Research, and Mr H F Wimperis, director of scientific research, Air Ministry The secretary is Mr H Brittain, a principal at the Treasury

As was indicated in our leading article of May 11, the impending appointment of an inquiry into the organisation and lay out of the research and experimental branches of the Civil Service was used in April last by the representatives of the Government on the National Whitley Council for the Civil Service as a reason for refusing a Joint Committee which the Staff Side at the instance of the Institution of Professional Civil Servants, had proposed It was understood that the official committee then foreshadowed would cover the whole of the research and experimental activities of government departments and would deal mainly, if not exclusively, with the widest questions of structure and organisation Under the terms of reference now announced, however, the committee's sphere of action does not include the Museums, the Observatories, or the Research Services of the Ministry of Agriculture and Fisheries, and its authority to deal with matters of high policy is apparently confined to examination We are also a little mystified by the relationship of this new committee to the Research Co ordination Sub Committee of the Committee of Civil Research which was appointed in 1926 under the chairmanship of Mr W G A Ormsby Gore, and which presumably is continuing to function, since the report which it issued last year was purely descriptive in character We understand that the Institution of Professional Civil Servants, which represents the staffs to be considered by the committee of inquiry, has been invited to submit evidence, but has not yet decided its policy

EDUARD SUESS the most illustrious member of the great school of geology in Vienna, was born in London on Aug 20, 1831, and the Geological Society has placed a memorial tablet on the house, 4 Duncan Terrace Islington The tablet was unveiled on May 28 by his Excellency the Austrian Minister, Baron G Frankenstein The president of the Geological Society, Prof J W Gregory, remarked that Suess came of a family that was settled in South Saxony by 1524 His father was destined for the Church in which many of his ancestors had served, but he entered the wool business and lived for a time in London He removed to Vienna, where Eduard Suess graduated at the University served on the staff of the Royal Museum and was appointed professor at the University in 1857 Suess applied his geological knowledge to the provision of a better water supply for Vienna and thereby effected a great improvement in the health of the city, which became a pioneer in the improvement of municipal water supplies Suess's world wide scientific reputation depends on his contributions to geology and physical geography His views were most fully published in his 'Face of the Earth", they were so original and unorthodox that he was for a while regarded as a visionary, and his writings set aside as 'geo poesy'

SUESS's main principles have been generally accepted and have had a fundamental influence on modern ideas of the internal structure of the earth and its geographical evolution Before his work it was generally believed that changes in the distribution of the sea and land were due to irregular local oscillations of the crust Suess held that they were mainly regular and world wide in range, and due to changes in the form of the earth that cause a general advance of the sea at one time and retreat at another The origin of mountain chains he attributed to the crust being folded by pressure in one direction forming waves which advance until they are stopped by older rigid masses of land, as waves of the sea are kept back by the projecting forelands along a coast Suess ranks as the greatest original force in the geological philosophy of his time, as well as being remarkable, for his influence as a far seeing educationist and municipal reformer, statesman, and economist The Austrian Minister expressed his pleasure at this recognition of the work of the great Viennese geologist The Rt Hon Sir Maurice de Bunsen, on behalf of the Royal Geographical Society, expressed appreciation of Suess's work Dr F A Bather, representing the Royal Society, referred to the scientific imagination with which Suess handled his material Alderman Harper, the Mayor of Islington, promised that the local authorities would see to the safety of this memorial to one of the illustrious sons of Islington Sir Arthur Smith Woodward and Prof W J Sollas, in moving a vote of thanks to the Austrian Minister, referred to Suess's nobility of character and literary distinction

A PARTICULARLY interesting account is given in the *Engineer* of May 31, of the replica of the famous locomotive *Rocket*, which won the competition at

Rainhill on the Liverpool and Manchester Railway in October 1829, and at the same time established once and for all the suitability of the steam locomotive for railway work The original *Rocket*, or what remains of it, stands in the Science Museum, South Kensington, but the replica has been made for Mr Henry Ford for his museum at Detroit The task of building the new *Rocket* was given to Messrs Robert Stephenson & Co, Ltd, Darlington, the successors of the old Stephenson firm at Newcastle, and immense pains have been taken to follow as closely as possible the original plans As is well known, the original *Rocket* was altered very considerably and to day many parts are missing The design of the fire box—one of its most important features—has long been a matter for inquiry and discussion but apparently the experts are now fairly well agreed as to the details, and in the replica Mr Ford possesses what is undoubtedly the most complete piece of engine reconstruction ever carried out Though there are various memorials to George and Robert Stephenson and to Henry Booth, who were jointly responsible for the building of the *Rocket*, on June 8 we shall possess another memorial to George Stephenson, for on that day the Lord Mayor of Newcastle upon Tyne will unveil a tablet on the cottage at Wylam, Northumberland, where he was born The tablet has been erected through the joint efforts of the North East Coast Institution of Engineers and Shipbuilders and the Institution of Mechanical Engineers

MR E B FORD, of the Department of Zoology, University of Oxford, delivered a lecture before the Eugenics Society in the rooms of the Royal Society on May 29, on "Recent Work on the Physiology of Genetics and its Bearing on Human Problems" Mr Ford stated that the physiology of genetics has only been studied in comparatively recent years Indeed, it could scarcely have been investigated until a considerable body of evidence respecting the mechanism of inheritance had been built up Such evidence has now been obtained, and has resulted in an accurate knowledge of the behaviour of genetic factors and of the characters for which they are responsible, but the developmental processes by which these characters are produced are still for the most part obscure Prof R Goldschmidt in Germany has, however, thrown some light on this part of the problem He was led to postulate factors controlling the *rate* of production of sex differentiating substances in his work on sex determination, and later in other characters, in moths However, these are animals which differentiate by means of sudden metamorphoses For this reason they are unsuitable for an investigation of developmental processes This difficulty has to some extent been overcome in Great Britain by the study of a Crustacean which grows and develops throughout life By this means it has been possible to examine in detail a number of factors affecting the rate and time of onset of processes in the body, and their interaction with each other and with the environment It is probable that factors of this type are of great importance in the mammals In man they should be of particular interest, since so many of the differences which separate the human species from the apes are qualitative, and depend upon rates of development and the time at which certain processes begin We have here an indication of how such differences are inherited and controlled

THE Zoological Society of Scotland has entered upon a new and important stage of its steady development The large area of ground, formerly a golf course, which rises to the ridge of Corstorphine Hill, has been taken over, a road has been made traversing the new ground, large grass paddocks have been partitioned off, and a series of enclosures in the live rock has been created for beasts of prey at a cost of some £3500 Great improvements also continue to be made, we learn from the sixteenth Annual Report, in the older part of the Park Unsightly cages have been replaced by rock dens, and an extensive monkey house, designed on modern lines and now in course of erection, promises to be as successful as the recently built houses for tropical birds and reptiles The application of a device for the circulation and filtration of water has enabled the director secretary to add a number of salt water tanks to the Aquarium, much to its gain in attractiveness, and at a cost very much less than that of the original proposal for storage tanks During the year 86,000 visitors entered the Park, and the accounts show a record surplus on the year of more than £4700

THE teaching of Nature study in schools has been a problem bristling with difficulties, and to these difficulties is largely due the predominant place in school teaching taken by the more concrete sciences of chemistry and physics Part of the trouble is due to the impossibility of finding teachers with the necessary outlook and training, and this, we are inclined to think, may be traced to the tendency of the training colleges to model the biological syllabus too closely upon the botanical and zoological courses in the Universities That is to say, too much stress has been laid upon the structure and systematics of plants and animals and too little upon life activities It is, therefore, with unusual pleasure that we welcome a course of Nature study, which in the hands of an intelligent and sympathetic teacher should bring to the class room the real feeling of the progression of living things The course is outlined week by week in *The Schoolmistress*, under the title "In England—Now!" by Mrs Maribel Edwin, the daughter of Prof J Arthur Thomson The general scheme of the series is to follow natural history the year round in Britain, and this is accomplished by striking in the first week of each month the keynote of the month, and in the succeeding weeks, by analysing the month's activities in greater detail The treatment exhibits insight and imagination, and the wall diagram, on which pictures of the creatures and plants referred to may be hung in their appropriate environment month by month, strikes a practical note which must appeal to teacher and pupil alike

THE fifth meeting of the Wool Breeding Council, appointed jointly by the Secretary of State for Scotland and the Minister of Agriculture and Fisheries

to advise the Departments of Agriculture for England and Wales and Scotland on questions relating to the improvement and utilisation of wool grown in Great Britain, was held at the Animal Breeding Research Department University of Edinburgh, on May 23 Sir Robert Greig, chairman of the Council, presided Short statements on research work in progress were submitted to the Council In co operation with the University College of North Wales, Bangor, large scale breeding experiments have been conducted in order to determine the mode of inheritance of the birth coat of lambs and the relationship between the type of birth coat and kemp in the subsequent fleece At the Animal Breeding Research Department, University of Edinburgh, the work includes a critical repetition of the grafting experiments carried out by Dr Voronoff a study of the rôle of the pituitary gland in producing early maturity, and an investigation into the possibility of securing the moulting of kemp by the use of thyroxin

DR E N DA C ANDRADE described "The Air Pump Past and Present" in a discourse delivered by him at The Royal Institution on May 31 The obtaining of a vacuum is an essential step in the majority of modern physical experiments, and in many of the products of the modern electrical industry, such as the electric lamp, the thermionic valve, and the X ray tube With modern methods a pressure of a ten thousand millionth of an atmosphere can be attained, which means only a few hundred million molecules per cubic centimetre During the past sixteen years new principles of obtaining high vacua have been applied which have proved of the utmost importance for the laboratory and electrical work shop At very low pressure the free path between the collision which a molecule makes with others is long, and the new pumps do not come into action until this state has been reached, and so work in conjunction with a preliminary pump which reduces the pressure sufficiently In one type a cylinder provided with special grooves rotates very rapidly, and actually throws the molecules forward as sparks are thrown by a grindstone this type of pump is usually called a molecular pump, and is very efficient, but demands great care in construction In another type, which might with equal justice be called a molecular pump, since it is based on a consideration of molecular properties, a jet of vapour entrains the molecules which diffuse into it, and the pump is therefore often called a diffusion pump The vapour itself has to be condensed, so the pumps are also called condensation pumps Hitherto mercury vapour has generally been used for these pumps, on account of the non volatile nature of the liquid at ordinary temperatures, but within the last year oils have been produced which can take its place, and within the last month or two another liquid still has been utilised

THE first David Ferrier lecture of the Royal Society will be delivered on June 20 by Sir Charles Sherrington, upon the subject of "Some Functional Problems attaching to Convergence"

DR H S H WARDLAW, of the Department of Physiology of the University of Sydney, has been elected president of the Linnean Society of New South Wales for the current session

PROF RAYMOND A DART professor of anatomy in the University of the Witwatersrand, Johannesburg, has been elected a corresponding member of the Italian Society of Anthropology, Ethnology, and Comparative Psychology The society was founded in 1871 and the number of corresponding members is limited to ninety

FURTHER information is now available with regard to the large earthquake which was recorded at Kew Observatory and other seismological stations on May 26 In a message which was broadcast on May 27, in code, from Arlington the United States Coast and Geodetic Survey gives the position of the epicentre as in Lat 56° N Long 137° W, that is under the Pacific Ocean, about 100 miles from Sitka, Alaska The time was 22 hr 40 min G M T, which is 14 hr 40 min Pacific Coast time

BY kind permission of the director of the Rothamsted Experimental Station, Harpenden a summer meeting of the Royal Meteorological Society will be held there on Wednesday afternoon, June 12 Fellows will make a general tour of inspection of the various departments, and will visit the classical field plots and the meteorological station, where a number of recording instruments are maintained

AT the general meeting of the Imperial Academy of Japan, held on April 12, Sir Alfred Ewing was elected a foreign member The president, in announcing this election, stated that the Academy most highly appreciated Sir Alfred's numerous and important contributions to science and gratefully remembered his untiring efforts in promoting in Japan the spirit of studying science for its own sake when scientific study was just beginning to be pursued in that country half a century ago

THE New York correspondent of the *Times* announces that Prof Henry Fairfield Osborne president of the American Museum of Natural History has secured from the Muller heirs in Sao Paulo Brazil, the originals of an entire series of letters from Charles Darwin to the great German naturalist, Dr Fritz Muller, with the view of sending them to be added to the memorial collection at Down House

APPLICATIONS are invited for the following appointments, on or before the dates mentioned A science teacher for day and evening work at the Walker Technical College, Wellington Shropshire—The Principal, Walker Technical College, Hartshill, Wellington Shropshire (June 11) A lecturer in engineering at the Wigan and District Mining and Technical College—The Principal, Mining and Technical College, Wigan (June 12) A full time assistant lecturer in pharmaceutical subjects, and a full time lecturer in electrical engineering at the Leicester College of Technology—The Registrar, College of Technology, Leicester (June 19) An

adviser in agricultural chemistry in the University of Manchester—The Registrar, The University, Manchester (June 20) A lecturer in physics in the University of Durham (Durham Division)—The Head of the Department of Science, University of Durham, South Road, Durham (June 22) A lecturer in mechanical engineering at Armstrong College—The Registrar, Armstrong College, Newcastle upon Tyne (June 22) An assistant inspector under the Ministry of Agriculture and Fisheries for work in connexion with agricultural and horticultural education and research—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place S W 1 (June 24) Two assistant superintendents under the Geological Survey of India—The Secretary to the High Commissioner for India General Department, 42 Grosvenor Gardens, S W 1 (June 24) A director of the Bureau of Economic Research of the Commonwealth of Australia—The Official Secretary, Commonwealth of Australia, Australia House, Strand W C 2 (July 1) A professor of Indian history and archæology in the University of Madras — The Registrar, University of Madras, Triplicane P O Madras (August 19) An instructor in engraving and etching and an instructor in decorative composition and design in the new Higher School of Fine Arts Cairo—The Ministry of Education Cairo (Sept 30) A chemist under the Air Ministry, Kidbrooke, with up to date knowledge of analytical methods, organic and inorganic chemistry, with specialised knowledge of one of the following subjects (a) metallurgy, (b) petroleum technology, (c) non metallic aeronautical materials, i e lubricating oils, dopes, paints, etc , (d) textiles, also a chemist with analytical experience in organic and inorganic work, and, if possible, specialised knowledge of metallurgical chemistry or petroleum technology—The Secretary (I G), Air Ministry, W C 2 A supervisor for the scientific instrument testing department of W G Pye and Co - W G Pye and Co , Granta Works, Cambridge A laboratory steward for the bio chemical laboratory of University College London—The Secretary University College Gower Street, W C 1 A plant physiologist at the Welsh Plant Breeding Station, Aberystwyth — The Secretary, Welsh Plant Breeding Station, Agricultural Buildings Aberystwyth A laboratory assistant for the Health Department of the Government of Iraq—The Crown Agents for the Colonies, 4 Millbank S W 1 (quoting M/1546) A junior assistant at the Experimental Station, Porton—The Chief Superintendent, Chemical Warfare Research Department, War Office, 14 Grosvenor Gardens, S W 1

Our Astronomical Column

MATTER IN INTERSTELLAR SPACE —The existence of interstellar calcium, as evidenced by the detached [H] and [K] lines in stellar spectra, has for some time engaged the attention of Dr O Struve (see for example, NATURE vol 122, p 252) His latest researches, made in collaboration with Prof B P Gerasimović, and described in the *Astrophysical Journal*, vol 69, p 7, deal with the physical properties of calcium and other elements in interstellar regions Eddington's hypothesis of an interstellar substratum embodying the whole galactic system is regarded as the most satisfactory hypothesis at present, and the one most in accordance with both observational data and theoretical considerations This substratum consists of many elements in various states of ionisation, with an average density of the order of 10^{-26} The observed intensities of detached Ca^+ lines show a definite distance effect such as would be expected from a uniform distribution of Ca^+ with a density of about $3\ 6 \times 10^{-31}$ The substratum of interstellar matter appears to share the rotational motion of the stars round a distant central mass in galactic longitude 325°

THE SUNSPOT CYCLE AND THE CORONA —It is about half a century since it was first noticed that the form of the corona varies with the progress of the sunspot cycle Our knowledge on the subject has become more definite from the aid afforded by the long series of coronal photographs that is now available Recently, studies on the subject have been made by Profs H Ludendorff and S A Mitchell The latter contributes an article to *Popular Astronomy* for April, which discusses and amplifies Ludendorff's conclusions The ellipticity of the corona near the sun's limb is denoted by a, that at a distance of one radius from the limb by $a + b$, a varies very little with the sunspot cycle, its mean value being 0 04, b is zero at maximum sunspot activity and about 0 26 near minimum activity it appears, however, to reach its maximum a year or two before sunspot minimum Mitchell notes that the coronal spectrum appears also to change its type thus the line at λ6374 in the red, which is not often observed, was well seen both in 1914 and in 1925 these being at the same phase of the cycle It is suggested that the Wolf numbers are a better guide to the type of corona than the phase of the sunspot cycle, it is also noted that the corona of 1918 was abnormal, it occurred a year after sunspot maximum, and had most of the features of maximum type, but there were also the strong polar brushes associated with minimum type

OCCULTATIONS OF STARS BY VENUS —*Acta Astronomica*, series A, vol 2, contains a discussion by J Witkowski of the occultations of three stars by Venus That of the star BD - 0° 2554, mag 7, was observed at Teramo on Nov 9, 1895 This had not been predicted, and was observed by chance Prof T Banachiewicz predicted that of the 4th magnitude star η Geminorum on July 26, 1910, it was observed at seven observatories Dr L J Comrie predicted that of BD + 18° 1499, mag 7 4, on Aug 22, 1924 Both phases were observed at Neu Babelsberg, and the reappearance at Bergedorf

From discussion of these phenomena Mr Witkowski finds a correction of $-0\ 58'' \pm 0\ 23''$ to Hartwig's value of the diameter at distance 1, which is 17 552" This is in fair accord with Auwers's value 16 820" derived from the transits of Venus in 1874 and 1882 He finds corrections to the *Nautical Almanac* positions of Venus which agree fairly well with those found with the Greenwich Transit Circle The observations lead him to suspect some refraction of the stars due to the atmosphere of Venus

Research Items

Secret Societies and the Bull Roarer.—Mr. Edwin M. Loeb, in a study of tribal initiation and secret societies (*University of California Publications in American Archæology and Ethnology*, vol. 25, No. 3) makes a world-wide survey of the evidence and reviews the theories of previous writers on these features of social organisation. The tribal initiations fall into two classes, those which are exoteric, that is, those to which all members of the tribe are subject but in which no attempt is made to preserve secrecy as to details, and the esoteric, of which the detailed rites are kept secret. It is out of these latter that the secret society grows, the distinctive feature being that they are exclusive. Secret societies are not as in the opinion of certain writers to be connected with the matriarchate, and though totemism and the sib system attach themselves to secret societies in certain areas, tribal customs and secret societies belong to an older stage of social organisation than either. It is noted that while boys' initiations are tribal, that of girls is a family matter. Both boys' and girls' initiations are common among backward peoples. They occur among Negroids and Australians and regionally in the New World, but are lacking among other Mongoloids, and also among Caucasians with the doubtful exception of the 'mysteries' of ancient Greece. From the distribution it is inferred that these traits are of archaic, possibly palæolithic, origin, and not a matter of recent diffusion. As regards the bull roarer, earlier theories are to be regarded as untenable. It would be possible to regard it as of independent origin in different regions only if attention were confined to its use as a toy or for purposes of magic. In connexion with initiation and secret societies, it is always associated with a form of tribal marking, a death and resurrection ceremony, and an impersonation of ghosts and spirits. It is tabooed to women and is invariably represented as the voice of spirits; but when found outside the area of initiation rites and secret societies it is neither. As there is no psychological principle which debars women from the sight of the instrument in Oceania, Africa, and the New World, it cannot be regarded as due to an independent origin and it must be inferred that it has been diffused from a common centre.

Antagonism between Tuberculosis and Cancer.—From a statistical survey of the incidence of cancer (carcinoma and sarcoma) among tuberculous and non-tuberculous individuals, Prof. Raymond Pearl concludes that there is a marked and definite incompatibility or antagonism between the two diseases (*Amer. Jour. of Hyg.*, **9**, 97; 1929). Active tuberculous lesions were found at autopsy in only 6·6 per cent. of 816 persons having malignant growths, and in 16·3 per cent. of 816 persons without malignant tumours, but of the same race, sex, and age as the former group. In 886 persons of both sexes and races compared, who were the subjects of active tuberculous lesions, there were but 11 cases of malignant tumours, or 1·2 per cent. of the total number, but in a similar group of 886 persons with no recorded tuberculous lesions there were 82 cases of malignant tumours, or 9·3 per cent. It is only when *active* tuberculous lesions are present that the antagonism seems to exist, for *healed* tuberculous lesions occurred with equal frequency in the malignancy and control groups.

Breeding and Migrations of the Elephant Seal.—The two species of seals which we have had opportunities of studying in British waters have distinct but well defined and compact breeding periods. It is curious that the elephant seal (*Macrorhinus leoninus*) should have so diffuse a breeding period, but the evidences collected by Mr. F. McLennan Davidson leave the matter in no doubt (*Proc. Calif. Acad. Sci.*, vol. 18, April 1929). On Juan Fernandez young seals have been found from June 10 to Sept. 19; on Guadaloupe Island on Oct. 9, Mar. 5, and May 8; and on the Lower Californian Islands from Nov. 1 to Feb. 1. That is to say, young of the elephant seal have been found in practically every month of the year, although a certain allowance must be made for the fact that the young seals recorded were not in every case new born. Rothschild considered that a regular migration of the adult seals took place to the Chilian coast and the islands near (Juan Fernandez, etc.), but various facts suggest that such a migration is improbable. Elephant seals have been found in the Antarctic pack ice in January, pointing to a movement away from, rather than across, the equator; and the evidence of a prolonged breeding season as well as the presence of a considerable herd of elephant seals in North American waters during all seasons also tell against the possibility of a migration to Juan Fernandez.

The European Starling in North America.—Several attempts were made to establish the European starling in the United States before a successful introduction was made in 1890 at New York City. By 1896 it had become firmly established in this area and since that time its spread has been so rapid and its hold upon the country so secure that it must now be regarded as a naturalised member of the North American fauna. Within twenty years it had become one of the most abundant birds in the region about New York City and of local occurrence from Maine to Maryland. In another dozen years it had occurred in every State from the Atlantic to the Mississippi and from the Ottawa and St. Lawrence Rivers in Canada to the Gulf of Mexico, with outlying records in Nova Scotia, Iowa, Missouri, Kansas and Texas. The conquest has been viewed with some concern. It can scarcely be doubted that so great numbers of a new comer must affect adversely the numbers of native birds, and it tends to drive some away from the vicinity of houses by ousting them from nesting sites. On the whole the starling's feeding habits are probably beneficial, but the greatest danger arises from its custom of gathering in enormous flocks after the breeding season, so that harm is caused by over-concentration in crop areas or from the insanitary habits of the birds (May Thacher Cooke, in *U.S. Dept. Agr. Circular*, No. 40). These are complaints which have been proved against the birds in Great Britain.

Malaria Mosquitoes of South Africa.—In Publications of the South African Institute for Medical Research, vol. 4, 1929, pp. 83-170, Messrs. Alexander Ingram and Botha de Meillon contribute the second part of a "Mosquito Survey of certain Parts of South Africa with Special Reference to the Carriers of Malaria and their Control." It deals with survey work carried out in the eastern and northern Transvaal during a portion of the malarial season, which is considered to last from January to May. The two recognised carriers of malaria in South Africa—*Anopheles funestus* and *A. gambiæ*—differ essentially in their breeding habits. *A. funestus* prefers the edges of slowly running streams, which are in deep shadow, for oviposition, while *A. gambiæ* resorts to shallow pools or puddles exposed to sunlight. *A. gambiæ* shows a decided seasonal prevalence, whereas *A.*

funestus does not appear to exhibit this feature It is because *A gambiæ* is much the more numerous of the two species during the malaria season that the authors regard it as the main malaria carrier They consider that concentration upon the reduction in numbers of this insect is more likely to bring about a diminution of malaria than an indiscriminate attempt against Anophelines in general The paper includes detailed descriptions of the larvæ and pupæ of certain South African mosquitoes not hitherto described, and these descriptions are accompanied by 28 illustrations

LUMINOUS SQUIDS —M Ishikawa (*Proc Imp Acad Sci*, Tokyo, January 1929) describes *Abralia japonica*, a new species of luminous squid from the Sea of Japan The total length of the squid is 116 mm Numerous minute luminous organs, as dark bluish dots with a paler opaque lens in the centre, are distributed over the ventral surface of the mantle, head, funnel, and the ventral and third arms On the ventral periphery of the eye are five circular luminous organs, brownish orange in colour, visible through the outer integument which covers the eye T Kishitani (*Proc Imp Acad Sci*, Tokyo, December 1928) gives a preliminary account of the pair of luminous organs of *Loligo edulis*, which are sunk in the ink sac, one on each side of the rectum The author has found a coccobacillus in the tubules of the gland tissue which forms the luminous part of the organ, and records the cultural characters of the organism and its action on sugars

RUST RESISTANCE OF WHEAT —The resistance of wheat to leaf rust, *Puccinia triticina*, has generally been regarded as a definite, heritable, and relatively stable character However, several workers have recently demonstrated that differences in external conditions, such as the variation between growth in the field and in the greenhouse, may have an important bearing on the crop's resistance to this disease C O Johnston and L E Melchers have now shown (*Journal of Agricultural Research*, 38, p 147) that under greenhouse conditions the age of the wheat plant is frequently an all important factor in determining whether or not infection shall occur A number of different wheat varieties were tested by inoculations with rust at three distinct stages of growth, after one month, as the period of winter dormancy was just ended and also when the head had fully emerged Whereas some varieties changed but little in their reaction to the disease, remaining susceptible or resistant throughout their growth period, others showed a definite alteration in their reaction according to their age Resistance, however, invariably increased towards heading time From the plant breeder's point of view, this affords a ready means of testing new varieties, since if resistant in the seedling condition, resistance is assured at all later stages of growth Thus new hybrids which appear promising but are really worthless on account of their susceptibility to rust may be discarded by means of this simple test before time has been wasted upon them Wheats showing an increase in resistance with age also showed a variation in the degree of susceptibility of their leaves The higher the leaf on the stem the greater its resistance to rust, from which the authors suggest that the change in the plant's reaction to the disease is probably correlated with some chemical or physiological change in the leaf

GREEN ALGÆ OF THE SEA OF JAPAN —The Pacific Scientific Fishery Research Station in Vladivostok just published in its *Bulletins* (vol 2, part 2, 1928) a paper by E S Sinova on the Chlorophyceæ of the Sea of Japan The work is based on numerous collections made by many Russian expeditions since 1870 and preserved in the Botanical Gardens and the University of Petrograd as well as on the personal observations by the author in 1926 The sea bottom is mainly rocky, and the rocks are covered by a continuous carpet of seaweeds The salinity of the water near the mouth of rivers is 32 33 per mille, and the principal genera of algæ present there are *Scytosiphon*, *Punctaria*, *Ulva*, and *Laurencia* All the rocky grounds in the northern part of the Bay of Peter the Great are overgrown by the 'sea cabbage', *Laminaria japonica*, which reaches gigantic dimensions and covers very large areas of the bottom This seaweed forms a basis of a very important industry, since more than 15 million pounds of the dry weed are exported annually to China for food and for technical purposes *Sargassum* and *Cystophyllum* occupy large stretches of the bottom, while *Zostera japonica*, *Z marina*, and *Z pacifica* form such dense colonies that navigation is made difficult in places Three new forms of *Laminaria japonica* are described and *Ceramium subverticillatum* (Grun) Web, described from New Caledonia, is recorded for the Sea of Japan for the first time A parasitic seaweed, *Streblonema* (*Ectocarpus*) *parasiticus* (Sauv), occurs abundantly on *Ceramium cubrum* (Huds) Ag, *Gracilaria confervoides* (L) Grev, and on *Camphœlophora hypneoides* J G Ag

DATA ON TERRESTRIAL MAGNETISM —The March issue of *Terrestrial Magnetism* contains a wide variety of articles on theoretical and observational aspects of the subject, the diamagnetic theory of the daily magnetic variation is discussed by its author, Ross Gunn, and by S Chapman, and the density and other conditions in the outer atmosphere are described in an interesting speculative paper by H B Maris Hafsted and Tuve report observations, by means of wireless echoes, of abnormal changes of height of the reflecting ionised layer in the upper atmosphere during magnetic storms There is also a list of preliminary values of the ocean magnetic determinations made by the non magnetic ship *Carnegie* on its voyage from Balboa to Easter Island and Callao, October 1928 to January 1929, the promptness of publication of such observations is a matter on which the Department of Terrestrial Magnetism of the Carnegie Institution of Washington can feel just pride

LUMINOSITY OF THE NIGHT SKY —The Australian Commonwealth Solar Observatory has issued its first publication (*Memoirs*, vol 1, No 1), entitled "The Luminosity of the Night Sky" It describes the observations made with a Rayleigh night sky photometer during 1926 and 1927, first at Canberra, and later at Mount Stromlo, about seven miles away The green auroral light has high values in March and April, whereas in England the maximum is in October, in each case there is a suggestion of a second maximum near the other equinox Dr Duffield, the director, found that the blue part of the spectrum was likewise unusually intense near the equinoxes, and attributes this to nitrogen bands such as occur in the spectrum of polar auroræ, themselves specially frequent at these seasons hence he supposes that the equinoctial maxima of the green auroral light are due to polar auroræ At other times of the year, though there is an excess of green auroral light over that to be found in diffuse light from the sun or moon, there is no evidence of excess blue radiation He therefore accepts Rayleigh's distinction between polar and non polar auroræ The period of observation, two years, is too short to indicate whether there are changes of the night sky light associated with the sunspot epoch, and it is greatly to be hoped that these southern observations will be continued for several years

Thermo electric Properties of Metal Crystals—The February issue of the *Proceedings of the American Academy of Arts and Sciences* contains an account of Prof P W Bridgman's investigations of the resistivities and thermo electric properties of rods of metal from a single crystal which he has carried out with aid from the Rumford Fund The rods 8 cm long and 0 3 cm diameter, are obtained by slow cooling from below upwards of a number of connected glass tubes inclined at different angles to the vertical, and filled with the molten metal The whole contents of the tubes are then parts of a single crystal The resistivities of rods of zinc, cadmium, antimony, tin, and bismuth, inclined at various angles to the crystalline axes, were found to follow Kelvin's law that they should be linear functions of the square of the cosine of the angle of inclination When each rod was soldered between copper leads and the junctions kept at different temperatures, the thermal electromotive forces were found to follow the same law, with deviations in the cases of tin and bismuth which are greater than the possible experimental error

Recombination Spectra—A neat experimental method for investigating the neutralisation of positive ions by free electrons has been described by Dr F L Mohler and C Boeckner in the March issue of the *Journal of Research* issued by the U S Bureau of Standards During the recombination, continuous spectra are emitted in the form of bands shaded to the violet, with their heads close to fundamental lines in the arc spectra of the resulting neutral atoms The distribution of intensity in the individual bands can be determined photometrically, and at the same time the concentrations of the ions and electrons and the average thermal energy of the latter, can be found by the probe wire method of Langmuir and Mott Smith, by combination of the electrical data and the optical data it is then possible to calculate the chance that a slow electron of specified speed shall fall into any one of the more important unoccupied orbits of the atom in question An outstanding feature of this work is that it confirms the somewhat surprising conclusion which had been arrived at from the study of the positive column of mercury arcs, that even under favourable conditions recombination in the gas phase is a relatively rare event The discharge tubes used by Dr Mohler were of a very simple type, being in fact almost identical with gas filled wireless valves containing helium or cæsium vapour, and operated in the 'blued' state

Single Crystals of Silver—Single crystals of various metals have been prepared in the form of rods or wires, and Hauser has obtained etch patterns, showing the crystallographic form, on spherical single crystals of copper and silver The first preparation of large single metallic crystals possessing the characteristic external form appears to be that carried out in the case of silver by Steacie and Toole and is described in the *Journal of the American Chemical Society* for April The metal is fused in the absence of air, cooled slowly and then kept at 940° for two days Dilute nitric acid attacks the faces of the single crystal thus obtained in a specific manner resulting in the formation of a prismatic crystal

Germanium Dichloride—The preparation of germanium dichloride, by passing the vapour of the tetrachloride, free from hydrochloric acid, over metallic germanium at about 430°, is described by Dennis and Hunter in the *Journal of the American Chemical Society* for April Germanium dichloride is a pale yellow solid which is instantly decomposed by moisture and is slowly acted upon by dry oxygen in accordance with the reaction $2GeCl_2 + O_2 = GeO_2 + GeCl_4$ It readily dissociates on heating, and hence cannot be purified by sublimation Germanium dichloride is unaffected by alcohol and chloroform but is hydrolysed by water, ammonium hydroxide solution converts it into an orange coloured substance

Apparent Influence of an Electric Field on the Boiling Point of Benzene—It has been shown by Baker that when an electric field is applied to benzene in a tube heated by an oil bath, the boiling point, as registered by a thermometer in the liquid appears to be considerably raised The same effect was later observed by Smits who showed that the vapour pressure remains unchanged and that if the heating is carried out directly with a flame the liquid boils at the normal temperature Smits attributed the phenomenon to superheating rendered possible by the removal of charged dust particles by the field In the *Journal of the Chemical Society* for April J W Smith describes experiments which show that the effect is very much reduced by vigorous agitation of the benzene, and when ebullition has commenced before the application of the electric field then the boiling point remains unaltered In all cases the vapour temperature has the normal value The explanation advanced by Smits appears therefore to be correct

Lanoline Rust Preventers—The Department of Scientific and Industrial Research has recently published an account (Engineering Research Special Report No 12 London H M Stationery Office) of an investigation of rust preventing mixtures carried out at the National Physical Laboratory Preservatives of a greasy nature are more satisfactory than hardening paints or varnishes, and the best results were obtained from lanoline either brushed on to a steel surface or deposited from solution Such coatings have very great adhesion to steel even at high temperatures Benzene is the best solvent to use for making up the lanoline solutions but solvent naphtha is more suitable for industrial use and is quite satisfactory Harder coatings can be obtained by the addition of paraffin wax or ceresin and if the solution is coloured, breaks in the film may readily be detected

Denicotinised Tobacco—An account of the so called 'denicotinised' tobacco is given by E M Bailey and others in the Report of the Connecticut Agricultural Experiment Station for 1927 (*Bulletin* 295) Many of these tobaccos are now on the market bearing the advertisement that the bulk of their nicotine has been removed, from which the consumer naturally concludes that the product has been rendered harmless Actual analyses, however, revealed the fact that on an average only one half to one third of the nicotine is removed in the re sweating process Further, since the percentage of nicotine varies enormously in different tobaccos, it is possible for a 'denicotinised' product to show as high a nicotine content as some other untreated tobaccos For example, the lowest percentage of nicotine found in a treated tobacco was 0 75, but certain types of Havana, Porto Rican, and Turkish tobaccos normally contain as little as 1 per cent From this it is clear that unrestricted indulgence of these tobaccos by people who suffer ill effects from nicotine is unwarranted The authors conclude with the suggestion that methods may be found which entirely remove the nicotine, though they raise the obvious query whether such refined tobacco would retain the qualities for which smoking is enjoyed

New Mining Department at Armstrong College, Newcastle-on-Tyne

ON May 14, H.R.H. the Prince of Wales opened the new Mining Department of Armstrong College. In his opening speech he said: "The industry is confronted with stern competition from overseas. It must be equipped to meet that competition, and I think it is generally agreed that it is to science that we must look in our distress. Science must show the way to an improvement in our methods, and scientific training must be available both for the leaders and the rank and file, so as to ensure that no single ounce of energy is lost in the tug of war against our competitors."

The demand that Armstrong College should intensify and enlarge its share of work of scientific research in the interests of the coalfields it mainly serves has recently become specific. The coal owners of Durham and Cumberland, the Federation of Iron and Steel Manufacturers, the Department of Scientific and Industrial Research and the coke and gas industries, have co-operated with the College in the formation of a committee to supervise and encourage the prosecution of researches bearing directly on their respective industries. This work is now well in hand; valuable reports have already been issued, and more may be confidently expected in the near future. Similar co-operation between the College and the Fuel Research Board has begun a physical and chemical survey of the coal seams in the northern coalfields is in progress, the chief purpose being to obtain an exact knowledge of the properties of those seams. This work is being carried out at present in temporary buildings, but it will shortly be transferred to the top floor of the new building.

The Department of Mining in Armstrong College has long and fine traditions behind it. It forms the oldest mining school in Great Britain, for it dates back in one form or another to the year 1837. Many of the foremost men in the mining industry to-day received their training in it. The present head of the Department is Prof. Granville Poole, who has designed the new building which now provides adequate facilities for the teaching of mining and the prosecution of research.

The erection of this building has been made possible only by generous grants from the Miners' Welfare Fund. The sum of £20,000 was subscribed by the Central Committee of the Fund and £10,000 from the Northumberland District Committee. Anonymous donors have contributed nearly £5000 to the equipment of the building and a further sum of £15,000 is required. The building will occupy a central position when the general scheme for the development of the College is completed. The architect is Mr. Dunbar Smith, of London, who was also the architect for the new College Library and for the National Museum of Wales, one of the noblest buildings erected in Great Britain within recent years.

Apart from the rooms set apart for research, the Department has several prominent features, for example, an exhibition hall containing plant and models of great educational value, and products from modern carbonising and hydrogenating plants, etc., also a specially equipped laboratory housing plant for the dressing of minerals.

The courses of the Department are arranged to meet the requirements of those who wish to specialise in any branch of mining, and the diploma and degrees obtainable are accepted by the Board for Mining Examinations in lieu of two years' practical experience in a mine.

Insect Nutrition and Metabolism

THE subject of nutrition and metabolism in insects is highly important, in that its adequate exploration is likely to provide fresh viewpoints for problems of insect control. At the same time its relation to such insect products as silk, lac, honey, and wax should not be overlooked. At the present time, knowledge of the metabolic processes of insects is limited to scattered experiments and observations usually confined to individual species, and of too inadequate a character to admit of reliable generalisations being made. The literature is very extensive and, for that reason, imparts the impression that a large amount of work has already been accomplished. A survey of any small branch in this field will, however, reveal how much of the available information is of a comparatively trivial or incomplete character, and what an infinitesimal amount of really fundamental knowledge has, so far, been gained.

In the *Transactions of the Entomological Society of London*, 1928, Part 2, Mr. B. P. Uvarov, senior assistant in the Imperial Bureau of Entomology, has brought together the results of all the work done on the subject of insect nutrition and metabolism. His memoir takes the form of an admirable introductory survey (65 pp.) of the range of problems involved, together with a bibliography of nearly six hundred titles. In the collation and examination of so large a mass of literature, the author has done a substantial service to entomology and laid the basis and provided a guide for future research.

If one selects, for example, the enzymes involved in the digestive processes of insects rather a surprising amount of data will be found available, but much of the material is the result of old, or of imperfect, methods of technique. There is also the fact that the part played by micro-organisms living in the digestive tract further complicates the subject. The need for clearly ascertaining which enzymes are produced by the insect and which by micro-organisms of symbiotic or other relationship is abundantly evident. With plant-sucking insects we have evidence that they are capable of converting starch into sugars, but we know nothing concerning their utilisation of the protein constituents of cell sap. Buchner went so far as to conclude that the symbiotic micro-organisms of aphids, coccids, etc., are able to utilise atmospheric nitrogen and so make up for a supposed deficiency in nitrogen absorbed by such insects from their plant hosts. It is, however, abundantly clear that there is no positive evidence indicating that sucking insects do not obtain and utilise all the nitrogen they need from the cell contents: we have to admit that the rôle of the symbionts is still unsettled.

Again, the problem of cellulose digestion in insects is very far from being settled in spite of the existence of tens of thousands of plant-feeding species. The presence of a cellulase has been found in very few insects and, for the vast majority of species, it would appear probable that, if cellulose is digested at all, it is by the intervention of micro-organisms, as has been so well demonstrated by Cleveland in the case

of termites We know surprisingly little concerning the nutritional requirements of blood sucking insects which are concerned with the transmission of the pathogenic agents of certain virulent diseases We need to know the length of time such insects can exist in the absence of a blood meal, the extent to which digestion of blood requires the interaction of micro organisms, the influence of different types of blood upon fecundity, and the extent to which the selection of one mammalian host in preference to another is a chemical or a biological problem

These few comments will serve to indicate the nature and importance of some of the problems involved It is to the credit of the Dietetics Subcommittee of the Civil Research Committee that it directed attention to the need for examination of the nutritional problem in insects Through the Empire Marketing Board it was able to arrange with the Imperial Bureau of Entomology to produce a collated bibliography of the whole subject, and Mr Uvarov's memoir was the result On the submission of the MS to the Civil Research Subcommittee, the latter body approached the council of the Entomological Society of London, through the Empire Marketing Board, with a view to its publication It must be added that the financial provision was made by the Empire Marketing Board, and that it affords yet another example of the breadth of view and wise foresight exercised by that Board in the furtherance of applied biological research

The inception, preparation, and publication of this memoir reflects the greatest credit on all concerned It may be added that Mr Uvarov's actual summaries of the papers listed in his bibliography have been deposited in the Reid Library of the Rowett Research Institute for Animal Nutrition, Aberdeen Arrangements have also been made for a set to be placed in the Science Library at South Kensington where they will likewise be available for consultation A limited number of copies of Mr Uvarov's memoir are available on application to the Secretary Committee of Civil Research 2 Whitehall Gardens, S W 1 A D IMMS

Annual Visitation of the Royal Observatory, Greenwich

AT the annual visitation of the Royal Observatory, Greenwich, by the Board of Visitors on Saturday, June 1, the Astronomer Royal presented his report, which describes the work of the observatory during the year ended on May 10 The observations with the transit circle numbered nearly nine thousand embracing the sun, moon, planets (of which special attention was paid to Vesta owing to its value for determining the equator point), fundamental stars and stars needed for comparison with Eros at the time of its near approach to the earth in 1930-31 The correction to the longitude of the moon as calculated from Brown's tables is +5 51" from the limb and +5 83" from the crater Mosting A The correction has been diminishing at the rate of a third of a second per annum since Brown's tables were introduced into the almanacs in 1923 The early observations of the sun and moon, from 1751 onwards, have been re reduced, it is found that the longitudes deduced from the declinations are more trustworthy in the early years than those from the right ascensions The results give support to the theory that there are variations in the earth's rate of rotation, they also indicate a secular acceleration of the sun's longitude, the amount of which is +0 78" in a century

Observations with the Cookson Zenith Telescope show that the variation of latitude in recent years has been abnormally small the large amplitude of seven years earlier has not been repeated

The 28 inch equatorial has been used for double star observation, 282 stars have been measured during the year, 44 of which are separated by less than half a second, a new working list of some 2000 pairs discovered by Dr Aitken has been prepared The old water clock used for driving this instrument, and its predecessor the Merz equatorial, since Airy's days has been superseded by an electric drive of the Gerrish type, which was on view for the first time at the visitation The Astronomer Royal gratefully acknowledges the help given in preparing the plans by Mr F J Hargreaves, who had used a similar drive successfully on his small equatorial at Kingswood, Surrey It was with this instrument that he was the first to photograph the comet Grigg Skjellerup at its return in 1927

Thirty one stellar parallaxes were determined with the Thompson 26 inch equatorial during the year, bringing the total up to date to 400 A useful economy has been introduced of taking two parallax fields on the same plate this halves the time spent in development

The 30 inch reflector is being used for the determination of colour temperature of stars The absolute temperatures are obtained by comparison with the positive crater of a carbon arc lamp which is mounted on the roof of the octagon room 600 feet away Twenty four early type stars, distributed as uniformly as possible round the northern hemisphere, have been selected as standards, forty other stars have now been compared with these the comparisons being made at the same altitude in each case Some notes on B type stars of abnormally low temperature were published in the *Monthly Notices* last year

With the astrographic equatorial, plates are being taken for comparison with those taken twenty five to thirty years ago in order to determine proper motions The result of this study for the zones from Decl +64° to +72° is now in the press The sunspot curve gives indications of a double peak in 1926 and 1928 respectively Daily spot numbers both of the whole disc and of the central region, are sent to Zurich for the Bulletin which is published there under the auspices of the International Astronomical Union

The magnetic elements determined at Abinger for the year 1928 are Decl 12 47 0 W Hor Force 0 18564 Vert Force 0 42941 Dip, 66° 37 3 the Decl is diminishing about 12 per annum

The mean temperature of the year ending on April 30, 1929 (misprinted 1928 in the report), was 48° 7 or 0° 8 below the average Frost occurred on 71 days the rainfall was 20 46 inches, or 3 78 below the average March, with 0 038 inch, was the driest month ever recorded at Greenwich

The performance of the two Shortt sidereal clocks has been very satisfactory the temperature in the clock cellar is now maintained at 62° 8 Fahr The progressive increase of losing rate still continues it is proposed to substitute a bob of invar on one of the clocks

Daily comparisons of time are made with Paris, Nauen, Annapolis, and Bordeaux In all four cases the residuals appear to show an annual wave

Allusion is made to the eclipse expedition to Kedah and Siam The total equipment weighed ten tons Unfortunately, no results were obtained in the investigation of the Einstein bending of light, but some results on the corona and prominences were obtained at Alor Star A C D CROMMELIN

Wisconsin Limnology

THE veteran limnologist, Dr E A Birge, together with Dr Chancey Juday and other collaborators, has made several additions to the detailed study of Wisconsin lakes in the *Transactions of the Wisconsin Academy* vol 23, *Proceedings of the American Philosophical Society*, vol 66, and in *Ecology*, vol 8 The Academy papers deal with the temperature of the bottom deposits of Lake Mendota, with the chemical composition of its larger aquatic plants and with the phosphorus content of that and other Wisconsin lakes Temperatures were measured in the mud of Lake Mendota down to 5 metres, in depths of water from 8 m to 23 5 m The data accumulated are used to calculate the annual heat budget At the shallowest station this amounted to 2950 calories per sq cm and 1100 calories at the deepest Preliminary data on the heat budget of Karluk Lake Alaska are given in *Ecology*, July 1927 These are compared with the values given by lakes in Central Europe

Supplementing a previous study of the composition of *Cladophora* and *Myriophyllum*, analyses of *Vallisneria* and *Potamogeton* are now given Rickett had previously shown that Mendota, 10 4 sq kilometres in area yielded, in dry weight 1112 metric tons of *Potamogeton* and 736 of *Vallisneria* Of these, the latter has an ash content of 25 2 per cent, the former 11 4 per cent Their influence upon the water and soil of the lake must, therefore be very considerable The analyses are unusually detailed and record the amounts of certain important minor constituents, such as phosphorus, iron manganese, and silica, which are frequently omitted

The organic matter content of lake waters is considered in a preliminary survey (*Amer Phil Soc*), which, however, contains analyses from forty four lakes These are grouped into *autotrophic*, which derive their organic matter from internal sources only, namely, from the phytoplankton and attached vegetation and *allotrophic*, into which drainage brings soil and marsh extractives For each lake the organic matter is a fairly definite quantity, showing no great variation either with depth or time This is in striking contrast to the oxygen content, which is often greatly reduced in the deeper cold water, the hypolimnion, this during summer remains unmixed with the warm epilimnion

Analyses were made of the waters of eighty eight lakes to determine the soluble phosphorus existing as phosphate, also the phosphorus in organic combination This was done in order to ascertain whether the simple yearly cycle, observed in the open sea, could also be traced in these lakes The marine workers found a winter maximum and a minimum in early summer, lasting until August, the surface waters being, during the summer, almost or quite devoid of inorganic phosphorus, and the deeper waters—in shallow seas—being much reduced In the lakes, however, observations made in May, soon after the disappearance of the ice, and in July or August, were complicated by two factors—the very minute amount of inorganic phosphorus and its regeneration from the plankton Accordingly, no such simple seasonal cycle was revealed Possibly the rate of regeneration, rather than the absolute amount of phosphorus, may here be the limiting factor

In *Ecology* (8, No 4, 1927) an account is given of the occurrence of two crustacea, *Pontoporeia affinis* and *Mysis oculata* var *relicta*, which are regarded as 'marine relicts' Though thoroughly studied in Europe, their American distribution is imperfectly known It was found that *Pontoporeia* occurs chie[illegible] oxygen may fall below 1 c c per litre The breeding season extends from December to May *Mysis* was found in two lakes During summer it remains on the bottom during daytime, but may even reach the surface at night The breeding season extends from October to May

University and Educational Intelligence

CAMBRIDGE —The solicitors carrying out the will of the late Mr John Humphrey Plummer state that, in view of the many conflicting and wholly unauthorised statements that have appeared, the time has arrived when some authoritative statement should be made concerning the benefaction which will accrue to the University The residue of the estate is to be applied in perpetuity for the promotion and encouragement of education in chemistry biochemistry, physical science or such other allied subjects in the University as the trustees shall think fit The testator further expressed his desire and intention that his trustees should as soon as possible establish and endow a professorship or professorships each of the annual value of £1200 in accordance with a scheme to be devised The testator further expressed the wish that the trust should be known as the John Humphrey Plummer Foundation The trustees are advised that the estate should yield an income to the University of approximately £10 000 a year

The Drapers Company has made a grant of £1000 per annum for a further period of 10 years to the School of Agriculture

Dr H B Roderick and Mr G Stead have been reappointed University lecturers in medicine

EDINBURGH —Principal Sir Alfred Ewing announced at the meeting of the University Court on May 27, in connexion with the proposed internal reconstruction of the medical buildings at Teviot Place, that gifts have been intimated for this purpose of £20,000 from Sir William Dunn's trustees, and £35,000 from the Rockefeller Foundation, making a sum of £55,000 in all This, along with other moneys available, now secures the carrying out in its entirety of a scheme drawn up by Mr Balfour Paul, architect, in consultation with the heads of the departments concerned, whereby the medical buildings, erected in 1880 will be radically altered in their internal arrangements, so as to bring them in line with the most modern requirements for teaching and research The external aspect of the buildings, as designed by the late Sir Rowand Anderson, will remain unaltered The work will be begun in the summer vacation Certain portions of the reconstructed building will in future be associated with the name of Sir William Dunn in recognition of the generous gift from his estate

LONDON —The following doctorates have been conferred D Sc in metallurgical chemistry on Mr J C Hudson (Imperial College, Royal College of Science, and Royal School of Mines), for a thesis entitled "Third (Experimental) Report to the Atmospheric Corrosion Committee (of the British Non Ferrous Metals Research Association)", D Sc in agricultural chemistry on Mr V Subrahmanyan (Rothamsted Experimental Station), for a thesis entitled "Biochemistry of Waterlogged Soils"

MANCHESTER —Mr J B. M Hay, lecturer in engineering, has resigned on his appointment as head of the Civil Engineering Department in Bradford Technical College

Applications are invited for two Grisedale biological scholarships in, respectively, botany and zoology, each of the value of £200 Applications should reach the

READING.—Dr. T. Franklin Sibly, principal of the University of London since 1926, has accepted the invitation of the council to become vice-chancellor of the University in succession to Dr. W. M. Childs, who is retiring in September next.

AT the time of going to press, the following results of Parliamentary elections in University constituencies have been announced:—Cambridge (2): Mr. J. J. Withers, Mr. G. H. A. Wilson. London: Dr. E. Graham Little. Combined English (2): Sir Martin Conway, Miss E. Rathbone. Wales: Mr. E. Evans. Queen's, Belfast: Col. T. Sinclair.

THE New Education Fellowship (English section) gives prominence in its annual report for 1928 to the subject of parent education. At a conference which it called last September, it was resolved to form a National Council for Parent Education and Child Study, and a provisional committee was appointed with Dr. Basil Yeaxlee as chairman to undertake the preliminary work with the aim of correlating and extending the efforts of existing organisations for forming parent-teacher associations all over Great Britain, child psychology study groups, training of study group leaders, publication of pamphlets and magazines for parents, formation of libraries, panels of speakers, etc. The movement will be stimulated by a visit to Great Britain this summer of some of the leaders for similar movements in America and by the fifth international New Education conference to be held at Elsinore on Aug. 8–21. The Fellowship, of the English section, of which Sir Michael Sadler is president, besides organising biennially international conferences, maintains libraries and information bureaux, publishes magazines and in other ways promotes co-operation between educationists and between parents and teachers. Its watchwords are: Release spiritual and creative power in the child; study and respect the child's individuality; educate through innate interests; encourage co-operation rather than competition; co-educate; educate for service. The general theme of the Elsinore conference will be "The New Psychology and the Curriculum".

A CENSUS of graduate research students in chemistry in the United States in 1927 shows that they numbered 1934 in one hundred and forty universities, as follows: in organic chemistry 570, general and physical 430, industrial and engineering 183, physiological 134, inorganic 116, agricultural 89, colloid 79, analytical 75, nutrition 58, catalysis 28, food 27, sanitary 25, photographic 25, metallurgical 21, five other sub-heads 74. The census has been taken annually for four years by the Research Information Service Division of the National Research Council, Washington, and discloses a steady growth in the total number of such students (1700, 1763, 1882, 1934), although under the various sub-heads the numbers fluctuate. In addition to these students, 1047 members of the faculty staffs were engaged in chemical research. In the pamphlet giving the results of the census (*Reprint and Circular Series of the National Research Council*, No. 84. Washington, D.C.: National Academy of Sciences, price 20 cents) figures are given separately under each sub-head for each university, together with the name of the head of the department of chemistry. In the same pamphlet are statistics showing the number and amounts of fellowships and other stipends received by graduate students in chemistry in 119 universities in the United States in 1927–28. Of the total number of such students, 45 per cent received no financial assistance either from the university or from outside organisations. More than one third of these self-supporting students (418) belonged to Columbia University, New York.

Calendar of Patent Records

June 9, 1683.—Great public interest was aroused by the patent granted on June 9, 1683, to Robert Fitzgerald and others for his process for obtaining fresh from salt water. A previous patent granted in 1675 to William Walcot for a similar invention was voided by the Privy Council on the ground that it had not been put into operation, and it is said that Fitzgerald's prescription, certified by Robert Boyle, was sent by Charles II. to the Lord Mayor "to be kept lest a secret of so great importance might come to be lost". But it was Fitzgerald's process that eventually proved a failure and Walcot's that triumphed. In 1695 an Act of Parliament was passed restoring Walcot's rights and granting him a 35 years' monopoly.

June 9, 1842.—The direct-acting steam hammer first reduced to a practical form by James Nasmyth was patented by him on June 9, 1842.

June 12, 1704.—The rise of the Irish linen trade is due very largely to Louis Crommelin, the leader of a small band of Huguenots settled in Belfast, who contracted with William III. to supply the requisite machinery and material and to teach the Irish the art of linen manufacture in return for the interest on his expenditure and £800 a year. On June 12, 1704, the Signet Office in London records a patent granting to the Board of Trustees of the Linen Corporation and the Lieutenant Justices of Ireland a yearly sum of £1180 for ten years for the purpose of encouraging the manufacture, the payment of £200 a year to Crommelin "for his paines and care in carrying on the work", and £120 a year to three assistants, with a pension of £60 a year to a French clergyman for the Huguenot colony.

June 12, 1806.—The purification of coal gas with lime was suggested in the early days of gas manufacture. Edward Heard, on June 12, 1806, patented a process in which the lime was charged with the coal in the retorts, but the proposal did not come into general use until it was reintroduced by W. J. Cooper in 1882.

June 13, 1551.—The first patent of which there is any record in France is that granted for ten years by Henry II. to Theseo Mutio, an Italian, on June 13, 1551, for making all kinds of Venetian glass. The manufacture was not successful, but the experiment paved the way for the subsequent encouragement of Italian workmen by Henry IV.

June 13, 1772.—William Tutin's is a noteworthy name in the history of the manufacture of shoe buckles, an important Birmingham industry in the eighteenth century. Tutin was the inventor of the alloy—made of brass, antimony, and tin—called "Tutania", of which most of the buckles of the period were made, and on June 13, 1772, he was granted a patent for a process of japanning buckles "so as to equal and far exceed in cheapness and wear the common blue coloured buckles, which are coloured by the heat of the fire, and are liable to be damaged by wet".

June 13, 1922.—Insulin, the pancreas extract used in the treatment of diabetes, was isolated by Dr. G. F. Banting and Dr. C. H. Best, of the University of Toronto, and in order to safeguard the public interest the method of extraction was patented in Great Britain on June 13, 1922. The University of Toronto invited the Medical Research Council to assume the responsibility for its production in Great Britain and conveyed the patent rights to the Council as a free gift. The word 'insulin' is due to Sir Edward Sharpey Schafer, who coined it about 1911 in anticipation of the discovery.

Societies and Academies

LONDON

Royal Society, May 30 — **O W Richardson** and **P M Davidson** The energy functions of the H_2 molecules The terms in the expansion of the force function are determined for certain states by various methods and show satisfactory agreement Negative total energies, heats of dissociation and other constants of about thirty H_2 states are tabulated Curves are drawn for the mean kinetic energy of the electrons of certain states at various nuclear separations An appendix contains a theorem on the mean energy of a system of particles in any condition of periodic motion, when some of the particles are fixed — **E K Rideal, C P Snow, F I G Rawlins**, and **A M Taylor** Infra red investigations of molecular structure (1) — **C P Snow, F I G Rawlins**, and **E K Rideal** Infra red investigations of molecular structure (2) The vibration rotation band spectrum of nitric oxide proves to be a fundamental with its centre at 1882 9 cm^{-1}, with the fine structure consisting of P, Q, and R branches with at least 42 rotation bands in each of the P and R branches The molecular constants derived from the separation of the fine structure bands (3 35 cm^{-1}) corresponds almost exactly with those obtained from electronic band spectral data The presence of a Q branch is in accordance with the gyroscopic character of an odd electron molecule The facts relating to the ground state of nitric oxide, its physical magnitudes, and its electronic angular momentum about the nuclear axis, form a consistent whole - **A Müller** The connexion between the zig zag structure of the hydrocarbon chain and the alternations in the properties of odd and even numbered chain compounds Starting from the fact that the CH_2 groups are arranged in a zigzag line it is shown that there must exist an essential difference in the structure of the odd and even numbered substances This difference accounts for the alternations of properties — **O W Richardson** and **F S Robertson** The emission of soft X rays by different elements at higher voltages — **L P Davies** The soft X ray emission from various elements after oxidation The effect of oxidation on the total soft X ray emission from the following elements has been studied Silicon, manganese iron, cobalt, nickel copper, molybdenum palladium, and tungsten The efficiency of the oxide seems to be the average efficiency of the oxygen and element present — **D L Chapman** and **W K Hall** A study of the catalysis by silver of the union of hydrogen and oxygen The new method of Hughes and Bevan was used and the conclusions confirmed by direct measurements of the falls of pressure which occur when the gases, separately and mixed together, are brought into contact with a large surface of silver The mechanism of the action seems to be one of alternate reduction and re oxidation of an oxide film The fact that a film formed at low temperature is more effective than one formed at a higher temperature suggests that some of the molecules of silver oxide in the former are in relatively unstable positions, and therefore more active chemically — **R H Fowler** and **A H Wilson** A detailed study of the 'radio active decay' of, and the penetration of α particles into, a simplified one dimensional nucleus The authors solve exactly for a simplified nucleus the problem of α particle disintegration (determination of the *complex* characteristics of the wave equation with the proper boundary conditions), and discuss the converse problem of the penetration of an α particle into the nucleus from without — **G I Finch** and **D L Hodge** Gaseous combustion in electric discharge (3) Combustion of dry detonating gas in the direct current discharge is primarily determined by the ionisation of both the constituent molecules of the gas Electrostatic forces keep apart positively charged ions, unless such forces are counteracted by some other agency, one such agency is negatively charged metal atoms sputtered from the cathode which, by forming electrically neutral metal gas complexes with positive ions, overcome electrostatic repulsion and thus enable combustion to proceed — **G I Finch** and **J C Stimson** The electrical condition of hot surfaces during the adsorption of gases (3) A hot platinum surface exhibits a charge when *in vacuo* or in contact with gases With alternate treatment with oxygen and hydrogen at 500° C, it will exhibit a charge in hydrogen or *in vacuo* at room temperature Heating at 850° destroys such superactivity The charge due to any gas can be rapidly removed by evacuation at 850° The destruction of the superactive condition is due to a structural change in the arrangement of the surface atoms akin to sintering — **J M Robertson** An X ray investigation of the structure of naphthalene and anthracene Using the rotating crystal photographic method, the general and statistical considerations of the reflections indicate a periodic structure parallel to the c axes of the crystals Geometrical structure factors are developed and the dimensions of the molecules calculated differ only slightly from those of Bragg's tetrahedral structure Thus the tetrahedral properties of the carbon atom are maintained in aromatic structures — **K Majumdar** The arc spectrum of chlorine The spectrum has been photographed in the region λ6400 8700 The ionisation potential is calculated as 13 1 volts — **K R Rao** The arc spectrum of germanium Observations have been extended to λ1630 and about fifty new lines have been added most of which have been classified The ionisation potential of Ge I is 8 09 volts approximately — **U Nakaya** On the emission of soft X rays by different elements, with reference to the effect of adsorbed gas The absorption of these rays increases with the amount of the adsorbed gas molecules on the photoelectric plate, while the excitation decreased with the presence of gas molecules Reliable data were secured by bombarding the photoelectric plate and target to red heat in the highest vacuum and afterwards reducing the oxide films on these surfaces with hydrogen - **N F Mott** The scattering of fast electrons by atomic nuclei The scattering of electrons by an atomic nucleus is investigated, using the wave equation of Dirac and a scattering formula obtained which gives the spin relativity correction to be applied, for fast β particles, to the usual Rutherford formula — **L J Freeman** Further investigations of the spectrum of ionised nitrogen (N II) Nine terms belonging to a quintet system have been identified and two new terms of the triplet system Some 75 lines have been newly classified — **A E Gillam** and **R A Morton** The absorption spectra of halogens and inter halogen compounds in solution in carbon tetrachloride — **R A Frazer** and **A J Duncan** On the criteria for the stability of small motions — **R A Frazer** and **W J Duncan** On the numerical solution of equations with complex roots — **G C McVitie** On Einstein's unified field theory

Physical Society, May 10 — **W E Sumpner** Heaviside's fractional differentiator The paper deals with (1) Heaviside's experimental methods, (2) the index operator, its definition and justification, (3) its use with Leibnitz's theorem, (4) its use with binomial and exponential expansion, (5) functions of the operator, (6) Heaviside's operators, (7) examples, (8) the impulse function — **J H Awbery** :

A simple method of fitting a straight line to a series of observations The method has a rational basis and can be carried out much more quickly than the method of least squares —E W H **Selwyn** Arc spectra in the region λ1600–λ2100 A simple method is described of photographing ordinary arc spectra down to about λ1600 Additions have been made to the analysis of the spectra of Mg I, Be I, and B I — **K R Rao** The spectrum of trebly ionised thallium —**G A Wedgwood** The elastic properties of thick cylindrical shells under internal pressure An experimental investigation of the usually accepted theory Longitudinal and diametral extensions were determined of a number of steel cylinders subjected internally to hydrostatic pressure, the cylinders being closed at the ends by covers secured to the shell itself Discrepancies seem to be due to the non isotropic nature of the material

PARIS

Academy of Sciences, April 29 —**Henri Villat** The alternating vortices of H Bénard in a canal of finite width — **E Mathias** Contribution to the study of fulminating matter Its two modes of decomposition A review of descriptions by witnesses of cases of globular lightning Certain of these describe the dissipation as without noise, in others, and these form the majority the disappearance was accompanied with very violent explosions —**J A Schouten** The geometrical signification of the semi symmetrical property of an integral connexion, which leaves invariant the fundamental tensor —**Georges Durand** A manner of conceiving the theory of envelopes — **D Pompeiu** Certain systems of linear equations and an integral property of functions of several variables — **René Lagrange** Certain functions associated with the functions of Legendre —**E Hille** and **J Tamarkin** A relation between the results of Minetti and Valiron —**Alex Véronnet** There are three distinct dynamics, and three only, corresponding to the three spaces of Euclid, Riemann, and of Cartan —**Lucien Féraud** Some applications of Pfaffian systems —**René Lucas** Remark on the equations of electromagnetism — **Neronoff** The law of attraction —**R Hocart** The diamagnetism of some binary halogen compounds The diamagnetism of the ions is not strictly additive, and hence it is not possible to describe the diamagnetic properties of substances by means of a single coefficient The coefficients of solutions of hydrochloric acid, common salt, and potassium chloride are given, the accuracy being from 0 1 per cent to 0 3 per cent — **G Föex** The diamagnetism of the crystal of azoxyanisol and the precession of Larmor —**Jean Becquerel** and **W J de Haas** The fundamental law of paramagnetic magnetisation of a crystal and the law of paramagnetic rotatory dispersion —**J Gilles** The trajectory *3d* in the ionised atoms P II, S II, S III, and Cl III Quadruplets of Cl III —**Charles Nordmann** A new method for the reproduction of colours —**Marinesco** The structure of solutions of gelatine A study of the relations between the dielectric constant of gelatine solutions and their concentration —**Nahmias** The evaluation of the α radiation of the active deposit of actinium by the measurement of its β radiation —**H Herszfinkiel** and **H Jedrzejowski** The conditions of formation of groupings of radioactive atoms —**René Delaplace** and **G Reblère** The irradiation of ergosterol the action of the ultra violet rays of quartz and of the soft X rays Diagrams are given showing the changes in the ultra violet spectrum of ergosterol produced by various times of exposure to ultra violet light Soft X rays produce effects qualitatively similar —**Antoine Willemart** The isomerisation of some acetylene carbinols into ethylene ketones The transformation of alcohols of the type $R_1R_2C(OH)-C{\equiv}CR_3$ into the ketones $R_1R_2C{=}CH-CO-R_3$ either by alcoholic sulphuric acid or through the chlorides is a general reaction Several examples are given —**Huan** The action of ethylmagnesium bromide on the tetrethyl diamide of succinic acid —**L Royer** The possible asymmetry of the corrosion figures obtained by an active isotropic liquid Results on the corrosion of calcite crystals are given which are in general agreement with the views of Hettich **A Amstutz** The crystallophyllian conglomerates of Mayombe, in the French Congo —**P L Violle** and **A Giberton** The antitoxic properties of calcium towards sparteine sulphate A guinea pig survived indefinitely the injection of a mortal dose of sparteine sulphate when the latter was mixed with a solution of calcium chloride —**Marc Bridel** Researches on the variation of colour in plants in the course of their drying The glucoside of *Lathræa clandestina* is aucuboside (aucubine) **Charles Pontillon** The pigmentation of *Sterigmatocystis nigra* cultivated on fatty media The yellow coloration sometimes observed in *Sterigmatocystis nigra* cultivated on fatty media is a consequence of the lack of homogeneity of the culture medium due to the mode of preparation of the mineralised gelose solution **René Wurmser** and **Jean Geloso** A glucose derivative a constituent of the oxido reduction equilibrium of the cells —**Mme L Randoin** and **R Lecoq** The primordial rôle of the alimentary equilibrium in the utilisation of lactose —**Edouard Chatton, André Lwoff,** and **Mme Marguerite Lwoff** The infraciliatures and the genetic continuity of recessive ciliary systems

Official Publications Received

BRITISH

Memoirs of the Indian Meteorological Department Vol Part 3 Data of Heavy Rainfall over Short Periods in India Pp 109 143 (Calcutta Government of India Central Publication Branch) rupees 1s

Supplement to the Journal of the Indian Mathematical Society Vol 17 Report of the Sixth Conference of the Indian Mathematical Society held at Nagpur in December 1928 Pp iii+24 (Madras)

Annual Report of the *Zoological Society of Scotland for the Year ending* 31st March 1929 Pp 63+8 plates (Edinburgh)

Indian Central Cotton Committee Technological Laboratory Bulletin No 19 Technological Series No 14 Further Tests on the Effect of Temperature and Humidity on Cotton Spinning By A James Turner Pp 17 (Bombay)

Quarterly Journal of the Royal Meteorological Society Vol 55 No 230 April Pp 103 214 (London Edward Stanford Ltd) 7s 6d

Apia Observatory Apia Western Samoa Report for 1926 Pp 98 (Wellington N Z W A G Skinner)

Air Ministry Aeronautical Research Committee Reports and Memoranda No 1204 (Ae 365) Wind Tunnel Experiments on the Design of an Automatic Slot for R A F 34 Section By F B Bradfield and F W G Greener (T 2682) Pp 11+4 plates 9d net No 1215 (Ae 371) The Accelerated Motion of a Cylindrical Body through a Fluid By H Glauert (T 2727) Pp 10 9d net (London H M Stationery Office)

The Physiological Society Session 1929–30 Rules List of Members and Dates of Meetings Pp 32+xlii (London University College)

Proceedings of the International Mathematical Congress held in Toronto August 11 16, 1924 Edited by Prof J C Fields with the collaboration of an Editorial Committee Vol 1 Report of the Congress Lectures Communications to Sections I and II Pp 935 Vol 2 Communications to Sections III IV V and VI Pp 1006 (Toronto The University of Toronto Press)

FOREIGN

Mitteilungen der Naturforschenden Gesellschaft Bern aus dem Jahre 1928 Pp xliii+269+6 Tafeln (Bern Verlag Paul Haupt)

Ministry of Agriculture Egypt Cotton Research Board Sixth Report, 1925–27 Pp x+104+29 plates (Cairo Government Press) 15 P T

Ministry of Agriculture Egypt Technical and Scientific Service (Botanical Section) Bulletin No 87 The Branching of Egyptian Cotton Plants By Dr J Templeton Pp 5+2 plates (Cairo Government Press) 3 P T

Scientific Papers of the Institute of Physical and Chemical Research No 188 The Uranium Thorium Ratio in Monazites By Satoyasu Iimori Pp 220 236 30 sen Supplement Vol 10 No 9 Geographical Distribution of certain Minerals in Japan By Satoyasu Iimori and Toyofumi Yoshimura. Pp 5 46 45 sen (Tokyo Iwanami Shoten)

Journal of the Faculty of Science Imperial University of Tokyo Section 2 Geology Mineralogy Geography Seismology Vol 2 Part 8 Neogene Shells from some Provinces of Chûgoku By Matajiro Yokoyama Pp. 363 368+1 plate (Tokyo Maruzen Co. Ltd) 45 sen

Department of the Interior Bureau of Education Bulletin 1928 No 25 Biennial Survey of Education 1924–1926 Pp iii+1204 (Washington D C Government Printing Office) 2 80 dollars

CATALOGUES.

Catalogue No 114 Zoologia Ip 60 (Paris Paul Lechevalier)
North America a Catalogue of Books, Pamphlets and Engravings (New Series No) Ip 136+4 plates (London Francis Edwards Ltd)

Diary of Societies

FRIDAY June 7

ROYAL SOCIETY OF MEDICINE (Laryngology Section) (Summer Meeting) at 10 A M —F J Clemmson M Woodman and W S T Neville Treatment of Carcinoma of the Œsophagus —H Barwell and Dr J A Gibb Inflammation in the Maxillary Antrum and Frontal Sinus —At Dr W J Horne Cancer of the Vocal Cords
INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (Scottish District) (at Town Hall Hamilton) at 10 30 A M —W H Purdie Hamilton Historical and Municipal —I Robertson Recent Road and Bridge Improvements in Lanarkshire —I A Leitch Notes on a Costing System —T M Stephen A Removal
GENETICAL SOCIETY (at Linnean Society) (Annual General Meeting), at 3 —Prof D E Lancefield The Genetics of *Drosophila obscura* —Dr C Stern Some Recent Work on *Drosophila*
PHILOLOGICAL SOCIETY (at University College) at 5 30 —Dr C T Onions The Supplement
GEOLOGISTS ASSOCIATION (at University College) at 7 30 —Dr A K Wells Dr A Brammall and others Discussion on The Value of Petrographic Character as a Criterion of Age
ROYAL INSTITUTION OF GREAT BRITAIN at 9 —C Leonard Woolley Excavations at Ur 1928–29

SATURDAY June 8

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS —Unveiling at Wylam at 2 30 of the George Stephenson Memorial Tablet by the Lord Mayor of Newcastle upon Tyne
MINING INSTITUTE OF SCOTLAND (at Y M C A Institute Ayr) at 4 —S Mavor Recent Progress in Underground Conveying

MONDAY June 10

PHYSICAL SOCIETY (at Imperial College of Science) at 5 —W E Pretty Pressure Shifts in Line Spectra of Gases —A S M Symons and J Daley The Zeeman Effect for the Arc Spectrum of Gold —Dr W Jevons The Band Spectrum of Lanthanum Monoxide
ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall) at 8 30 —F T Scott The Saura Oases and the Niger from Timbuktu to Jebba

TUESDAY June 11

ROYAL COLLEGE OF PHYSICIANS OF LONDON at 5 —Dr H H Dale Some Chemical Factors in the Control of the Circulation (Croonian Lectures) (III)
MINERALOGICAL SOCIETY at 5 30 —Dr G T Prior The Meteoric Stone of Lake Brown Western Australia —E J Wayland Bismutotantalite a New Mineral from Uganda Dr I Hawkes On a Partially Fused Quartz felspar rock and on Glomero granular Texture —Dr P Marshall The Occurrence of a Mineral Hitherto Unrecognised in the Phonolites of Dunedin New Zealand —Fuloppite a New Hungarian Mineral of the Plagionite semseyite Group Exhibited by Dr L J Spencer on behalf of L de Finály and Dr Sándor Koch
ZOOLOGICAL SOCIETY OF LONDON, at 5 30 —C Coles A Talk on Australian Birds illustrated with slides by Members of the New South Wales Royal Zoological Gardens —A E Ruxton and E Schwarz On Hybrid Hartebeests —E Schwarz On the Local Races and Distribution of the Black and White Colobus Monkeys —Sir Arthur Smith Woodward The Upper Jurassic Ganoid Fish *Heterostrophus* —Miss E M Brown Notes on Hydrogen Ion Concentration Excess Base and Carbon Dioxide Pressure in Aquarium Waters —I W Low Contributions to the Development of the Pelvic Girdle IV The Pelvic Girdle and its Related Muscles in the Batrachian *Amphiuma means* Gardner
QUEKETT MICROSCOPICAL CLUB, at 7 30 —C H Oakden Various Forms of Photomicrographical Apparatus
ROYAL ANTHROPOLOGICAL INSTITUTE at 8 30 —Miss J Gaultier de la Verendry Folk Songs of Canada, Eskimo Indian and French Canadian

WEDNESDAY, June 12

ROYAL SOCIETY OF MEDICINE (Surgery Section) (at Sheffield), at 2 and 6
ROYAL METEOROLOGICAL SOCIETY (Summer Meeting) (at Rothamsted Experimental Station Harpenden), at 2 15
RESEARCH DEFENCE SOCIETY (at 11 Chandos Street W), at 3 —Prof A V Hill Enemies of Knowledge (Stephen Paget Memorial Lecture)
GEOLOGICAL SOCIETY OF LONDON at 5 30 —Dr E Mackenzie Taylor Base Exchange and its Bearing on the Formation of Coal and Petroleum
EUGENICS SOCIETY (at Linnean Society), at 5 —W T J Gun Dr B Dunlop and others Does Industry need Dullards?

THURSDAY June 13.

ROYAL SOCIETY at 4.30 —F M L Sheffield Chromosome Linkage in *Œnothera* with Special Reference to Some F_1 Hybrids —Grace Briscoe and Winifred Leyshon Reciprocal Contraction of Antagonistic Muscles in Peripheral Preparations—using Flashing Neon Lamp Circuit for Excitation of Nerve.—W S. Stiles The Scattering Theory of the Effect of Glare on the Brightness Difference Threshold —T Moran Critical Temperature of Freezing—Living Muscle.—E C Smith The Formation of Lactic Acid in Muscles in the Frozen State
LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5 —Dr T J I'a Bromwich The Application of Operational Methods to some Electrical Problems in Diffusion —E T Copson and W L Ferrar Notes on the Structure of Sequences (II) A T Price Electromagnetic Induction in a Conducting Sphere —C T Preece Theorems stated by Ramanujan (X) —Prof G N Watson Theorems stated by Ramanujan (XI).
INSTITUTE OF PATHOLOGY AND RESEARCH (St. Mary's Hospital) at 5 —Prof J A Gunn Variations in Susceptibility to Drugs and Toxins
OPTICAL SOCIETY (at Imperial College of Science) at 6 30 —Experiments Demonstrations and Exhibits arranged by the Technical Optics Department of the Imperial College —Exhibits of New Theodolites by Cooke Troughton and Simms Ltd and E R Watts and Son Ltd —At 7 30 Dr W M Hampton The Beam given by Dioptric Apparatus
INSTITUTION OF ELECTRICAL ENGINEERS.—Summer Meeting in France (June 13–22)

FRIDAY June 14

ROYAL ASTRONOMICAL SOCIETY at 5 —T P Bhaskaran The Number of Stars of Different Magnitude in the Hyderabad Astrographic Catalogue Fifth Paper Zone —21 Prof F W Brown The Planetary Theory with the True Longitude as Independent Variable
ROYAL SOCIETY OF MEDICINE (Ophthalmology Section) (Annual General Meeting) at —E Maddox Demonstration of the Cheiroscope —Miss M Dobson Velanoskiascopy a Control in the Correction of Astigmatic Defects
MALACOLOGICAL SOCIETY OF LONDON (in Zoological Department University College) at 6

SATURDAY June 15

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Newcastle upon Tyne) at 2 30

PUBLIC LECTURES

FRIDAY June 7

KING'S COLLEGE at 5 30 —Prof H Wildon Carr The Philosophy of Leibniz (Succeeding Lectures on June 10 12 14 17 and 19)

CONFERENCES

June 5 to 8

SOUTH EASTERN UNION OF SCIENTIFIC SOCIETIES (at Brighton)
Friday June 7 at 11 A M —H Dewey The Denudation of the Weald —Dr G P Bidder Death (Address).
At 12 —E A Martin The Brighton Rubble Drift and Cliff Formation —A Griffith Some Sussex Birds and Insects
At 8 —Reginald A Smith Early British Art (Public Lecture)
Saturday June 8 at 10 30 A M —Prof H J Fleure Regional Survey Address
At 11 30 A M —D Edwards Town and Regional Planning

June 11 to 22

INSTITUTION OF ELECTRICAL ENGINEERS —Summer Meeting in France

June 13 and 14

INTERNATIONAL CONFERENCE ON LARGE HIGH TENSION SUPPLY SYSTEMS (at 9 Avenue Hoche Paris)
Thursday June 13—*In Morning* —Federal Railways (Switzerland) Recent Investigations and Tests on 132 000-volt lines —M Barrère Results Obtained in the Operation of a 120 000 volt System —I V Hunter and J F Watson Certain Aspects of the High tension Distribution Problem —S Fukunaka and Taizo Ueno The Snow Trouble on a 154 000 volt Transmission Line and its Remedy —F Courtoy Organisation of Electricity Generation in Belgium —G R Falkiner Nuttal Load dispatching in Large Electric Power Systems in the United States
In Afternoon —A Roncaldier Parallel Operation —A Smouroff Operation of Very Large Interconnected Supply Systems —U Del Buono Earthing the Neutral —I Maggi Experience with an Earthed Neutral on the 130-kv Systems of the Cisalpina Company
Friday June 14—*In Morning* —C I Budeanu Power Factor Improvement —F Rutgers Simplified Graphical Representation of Active and Reactive Power in Vectorial Diagrams —I Gratzmuller The Conservation of Reactive Power in Electric Systems —A Iliovici Measurement of Electrical Energy and Power at Very High Voltages —G Renesson Notes on the Measurement of Electrical Energy at High Voltages.—A. Barbagelata Metering and Tariffs in Three phase Supply
In Afternoon —L C Grant Lightning and Surges on High tension Transmission Lines.—R O Kapp The Selective Protection of Transmission Lines —P Traverse Investigation and Statistics on Surges in Transmission Systems.—F W Peek Developments in the Control of Lightning —Barbillion and Teszner The Rôle of Condensers and Similar Devices in the Protection of Networks Against Surges Theoretical and Experimental Study —K Gotoh and Matsunaga Lightning and 154 000 volt Transmission Lines —A. Iliovici Selective Protection of Networks Based on Unbalanced Currents Voltages and Power —A Tchernychoff A New Method of Protection for Heavy current Equipment —M Walty Long distance Communication in Electric Systems —A Tchernycheff Special Apparatus for the Protection of Long-distance Communication Lines.—German Telephone Administration Measurement of the Coefficient of Mutual Induction between Two Lines with an Earth Return —T N Schulz Standardisation of International Statistics in Regard to the Generation and Distribution of Electric Power —P Rieunier Interconnexion of Systems Operating at Different Frequencies —J Kopeliowitch The Use of an Ohmmeter as a Selective Relay —L. Gratzmuller Increasing the Number of Phases for a Supply to Mercury Converters, with a View to Reducing the Effect of Harmonics in a Distribution System.

SATURDAY, JUNE 15, 1929

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No 3111, Vol 123]

Science in the Public Service and Industry

WE commented last week upon the appointment of a committee to inquire into matters affecting the functions and staffs of certain research and experimental establishments of departments of Government This inquiry is, of course, separate from that of the Royal Commission on the Civil Service which Mr Baldwin recently announced would be appointed We trust that the change of Government will not mean that this Commission will be dropped A really wider issue than that of the position and functions of the technical expert in the Civil Service is involved, indeed the time is ripe for an inquiry into matters affecting the position and responsibilities of the man of science and the technologist generally, in industry as well as in the public services

For some considerable time a suspicion has existed that matters affecting the status and responsibilities of the technical expert are very far from satisfactory in Great Britain As regards the public services, it is possible nowadays, more or less, to gauge the situation, owing to the existence of the many specialised vocational associations which have, in recent times, been formed within the Civil Service and the Local Government Service for the purpose of protecting the interests of their members, practically all these associations periodically issue publications dealing with their activities, and thereby give an insight into the nature of the problems to which attention has been devoted Furthermore, the Royal Commission on Local Government appointed on Feb 14, 1923, under the chairmanship of Lord Onslow, has during the past twelve months taken evidence from some of these vocational associations, particularly in relation to the duties and status of the technical offices under the local authorities, in this evidence the practice of the central government has been touched upon, and its attitude towards its technical officers has been contrasted with that of the local authorities towards their chief officers who are engaged mainly on technical duties

In industry, no institutions with objects identical with those of the vocational associations referred to above exist, consequently, it is more difficult to obtain generalised information regarding the status and responsibilities of those engaged on the technical side of industrial and commercial undertakings In view of the great national importance of the subject, individual inquiries have been addressed in relation thereto to a number of persons engaged on technical duties in some of our

industries As might be expected, the information collected shows that in industry the conditions vary very widely, and also that the attitude of the chief officials responsible for the conduct of the affairs of various important concerns differs to some extent in relation to the status and responsibilities which should be assigned to the section of the staff which deals with the technical work In some cases the chief officials are unresponsive to the changing conditions of the times (needless to say, to the detriment of the businesses they control), whilst on the other hand, happily, many such officials are broad minded, progressive, and ever ready to meet the altered, and altering, conditions imposed by the more intense trade competition arising from the more exacting requirements due to increased scientific knowledge and to the high technical skill and ability of the staffs of their foreign competitors

Our inquiry into this subject has disclosed the fact that in industry old prejudices are gradually dying, and that, in recent times, a considerable improvement has taken place in the status of the men of science and the technologists who follow their careers in the commercial world There is still room, of course, for further improvement, which will no doubt come about in time, the matter seems to depend upon two factors, namely, on the introduction in our industrial enterprises of an organisation adapted to meet the very complex technical requirements of to day, and on the willingness of the technical expert fully to qualify himself for the more important administrative posts by devoting his time not only to the study of subjects of a strictly scientific and technical kind, but also of those bearing on the administrative and economic aspects of his work

The improvement in the status of the man of science and technologist to which attention has been directed is due, it has been suggested, to the rise and growth of the electrical industry It has been pointed out that many of the successful businesses connected with this industry have been founded, developed, and managed by men who have had the advantage of a scientific education and of a technical training, many of the most important posts are still held by a type of man with similar qualifications Being an entire new comer, and probably also by reason of the fact that much technical knowledge was involved in almost every decision, this industry was not hampered at its birth by some of the harmful traditions that have tended to limit the sphere of usefulness of the technician in the same way as has been, and still is to some extent, the case in some of the older ones The new policy has very greatly benefited the electrical industry and has enabled it to reach a flourishing condition

Now, a very cursory examination of the information contained in books of reference indicates that the improvement in the status of the technician is not confined to the electrical industry, almost simultaneously with its birth an infection seems to have spread to other industries It is on record that in 1883, when the late Sir William (afterwards Lord) Armstrong first founded his famous Tyneside shipbuilding works, he entrusted the organisation and the directing of this establishment to a technician, who some years later became Director of Naval Construction and Assistant Controller of the Royal Navy At subsequent dates, some of our railway companies selected officers from the technical side of their undertakings for high administrative posts Again, the chemical industry affords instances of chemists who have risen to the control of huge interests and have done well as administrators Men with technical knowledge and experience are also now occasionally appointed as directors on the boards of companies, this is so not only in the cases alone of those concerned with activities of an industrial kind, but it also applies equally to those whose interests are mainly financial or commercial

Apart from the government services and industry, there are the great municipal services The Royal Commission on Local Government now sitting has received a considerable volume of evidence on the aims and objects of the various vocational associations by witnesses representing them, and questions have also been raised by other witnesses as to the desirability, or otherwise, of arranging for interchanges of duties on the part of civil servants and local government officers by temporary transfers of staff from government departments, particularly the Ministry of Health, to the offices of local authorities, and vice versa Moreover, a proposal involving a fundamental change in the constitutional fabric of municipal government has also been put forward, namely, one relating to the appointment in our municipalities of a 'chief officer' corresponding to the burgomaster, who is supreme in relation to municipal affairs in certain continental cities, or of a person possessing the authority and the responsibilities of the city manager who is now in charge of municipal affairs in many important American cities Neither proposal, however, is given much support by local government officers

The town clerk, who is generally a member of one of the legal professions, is, by an almost immemorial custom, recognised as the principal officer of the Local Authority, he is *primus inter pares*, and, apart from the particular duties of his own department, co ordinates the various services of the council, in order to avoid overlapping and to prevent a course being taken by one department without consideration for its effect on another department It is, however, recognised that it would be most improper for a town clerk to criticise or interfere with a technical officer in the carrying out of the technical duties assigned to him, that is to say, the technical officers under a local authority severally exercise their functions independently of the town clerk The practice of local authorities differs, therefore, very widely from that of government departments, in the latter case, the technical branches are elaborately con trolled by the secretary's department

Some of the members of the Royal Commission appear to have been exercised in their minds with regard to the difference of treatment meted out to the two types of officers, the administrative and the technical, in the national civil service and in the local government service, in consequence, questions were put to some of the witnesses with the view of eliciting the reasons why in the latter service it is those with technical qualifications who hold the positions of 'chief officers', and it is considered that there is no field in it for the person without technical qualifications—the 'skilled ad ministrator'—although in the case of the Civil Service the former type of official "did not get to the top of it", whereas the latter type did so invariably

It has been pointed out that the difference in the treatment of the two types of officers in the two services may be accounted for historically, whereas the first services entrusted to a municipal corpora tion were of a character which required technicians at the head of them, on the other hand, the respon sibilities of government departments originally involved the consideration of problems in which the administrative aspect predominated It is further suggested that county and municipal councillors themselves do the administrative work, and rely directly on their officials for technical advice A century ago, ministers of the Crown were able to do, and personally did, a great deal of the administrative work of their departments, but, with the increasing complexity of the problems to be dealt with, the methods then in vogue went out of date and had eventually to be abandoned The system which was introduced later for dealing with the work of government departments has, in its turn, become obsolete

In the evidence given before the Commission, strong adverse criticisms have been made regard ing the narrow rules of the Civil Service, which, as a matter of practice, prevent an officer on the technical side, however well fitted and qualified he may be for the position, being promoted to the higher administrative posts In view of the fact that administrative ability of the first rank is so rare, the policy which prevails in the Civil Service in relation to this matter has been char acterised as being inexpedient, short sighted, and unjust

It is essential that ministers of the Crown should frankly recognise that government departments have completely outgrown the organisation with which they are now endowed, and even that their own positions therein, and the functions they are attempting to exercise, which are very similar to those of a general manager, no longer conform with the requirements of the day

Alterations of a far reaching character are, in consequence, needed in the organisations of our government departments One of the principal features of the reconstruction of such departments should be such as to provide that the functions assigned to ministers in charge of government de partments shall correspond with those of a chairman of a board of directors, or of a commission, and that they shall be aided directly by a body of highly qualified technical experts occupying positions somewhat similar to those of the directors of a company, and be given a distinctive title, for example, they might appropriately be called 'commissioners' If such a reform was carried out in a whole hearted manner, ministers would be placed in a better position than at present to obtain the technical advice required in connexion with the formulation of their policies, since it would reach them at first hand If, further, each of these 'commissioners' was also charged with responsibility for both the administration and the technical work of the various specialised branches of a government department, immediately under the direction of the responsible minister, the management of the public services under the central government would be more efficient and economical than is the case to day, and the ministers themselves would also be placed in a position to exercise their proper functions more effectively, and, consequently, their usefulness and the value of their work to the State would be enormously increased

Shellfish Pollution

Ministry of Agriculture and Fisheries Fishery Investigations, Series 2, Vol 10, No 1, 1928 *Report on Mussel Purification, being an Account of the Establishment of a System of Purification of Polluted Mussels, of the Experimental Work upon which it is based, and of certain General Considerations and Suggestions regarding the Sewage Pollution of Shellfish in its Public Health Aspect* By Dr R W Dodgson Pp xvi + 498 + 16 plates (London His Majesty's Stationery Office, 1928) 21s net

THIS encyclopædic summary and critical analysis of our knowledge of shellfish pollution will long remain the standard work of reference on a difficult problem hitherto baffling even the experts It is thus an essential addition to every up to date public health library But to public health authorities it is also a conspicuous milestone of progress, in that it records how scientific research, by evolving a method proved reliable through a dozen years of extensive practical trial, has solved the problem of purifying sewage polluted shellfish Seldom, indeed, does an official report on practically applied science reveal so many and so varied abilities as this its erudition, lucid presentation and scientific interpretation of facts, shrewd judgment, and sound business sense—all are so freely interspersed by touches of 'pawky' humour as to make its perusal a keen pleasure

Initially, Dr Dodgson reviews fully the literature on the existence and classification of human diseases attributed to eating shellfish 'Mussel poisoning', which is very fully discussed, is classified into three categories the erythematous, the paralytic, and the bacterial food poisoning type The characteristics of the first two, and the points to which attention is to be directed in making a differential diagnosis, are clearly set forth There should in future be no excuse for the confusion which has hitherto existed in some quarters in connexion with these conditions Dr Dodgson's analysis of the evidence establishes two points of much importance to the consumer, namely, that the erythematous type ('musselling') is never fatal, whilst the danger of contracting the fatal paralytic type is, if elementary precautions and common sense are exercised, for practical purposes negligible

The author then considers the correlation of shellfish pollution and certain human infections His initial six months' study of the physiology of the mussel was rewarded by the discovery of the cardinal fact that it filters from the water passing through it all suspended solids—including infective germs discharged by sewers into estuaries, which are most grossly polluted at low tide when shellfish are gathered Following up the trail of infection, he found untreated sewage entering estuaries from many forgotten sewers, the pollution from which was, in some cases, particularly pernicious, for example, that from isolation fever hospitals In one instance excreta from an enteric patient were discharged from a sewer mouth within 50 yards of a mussel bed on to which they flowed so rapidly that germs might enter the mussels within three minutes of being voided by the patient! This fully evidences the risk of human infection by the 150,000 cwt of mussels eaten annually, mostly uncooked, in Great Britain, particularly when, as Dr Dodgson indicates, the fresher the fish the greater is the risk of its retaining and passing on infection

The general position is summed up as follows (p 119)

"As long as dirty food—*polluted* shellfish—is used for human consumption, a serious gap must exist in the defences erected by public health effort against typhoid and other serious disease This gap is not only serious, but is one of the most pernicious of all possible gaps, for it means that we are permitting the infective material from typhoid fever patients and typhoid carriers, and that responsible for other grave diseases, to be poured on to a living article of food, so constituted as to be capable of collecting and concentrating within itself such infective material from an enormous volume of water, and, having permitted this to happen, we allow the concentrated infection to be distributed all over the country, just when we had hoped and believed that we had safely got rid of it, once and for all"

A review of remedies previously proposed shows the impossibility of keeping all sewage from all edible shellfish, and the impracticability of sterilising polluted shellfish by heat or by chemicals While urging that sewage from hospitals housing such cases as enteric should be compulsorily sterilised, chemically or otherwise, prior to discharge into any watercourse, the author shows that this method cannot be reliably or economically applied to the host of other sewers now discharging into our estuaries This section concludes with an able and comprehensive review of existing legal powers, which are shown to confer upon local authorities means of enforcing the simple and effective method of shellfish purification described below

The practical outcome of apparently abstract

research is aptly illustrated To aid in studying the course of water currents within the mussel, Dr Dodgson coloured water with fine carmine powder, and thus discovered that, as the water circulated within them, the mussels filtered off all the carmine, and extruded it firmly entangled in mucoid threads (fæces and pseudo fæces) which resisted disintegration for more than a month in still water Experiments proved that bacteria were similarly filtered off, and that even heavily polluted mussels rapidly freed themselves from polluting germs in water of suitable salinity and at ordinary temperatures Even at freezing point or there abouts similar results were obtained during the night or in artificially produced darkness In running sterile water three hours might suffice for the elimination of all bacteria

This remarkable result is largely achieved by the mussel's gills, which consist of a network of fine ciliated filaments The ciliary currents cause the water to circulate between the filaments suspended matter, including bacteria, being filtered off and becoming entangled in sticky mucus, finally to be extruded from the shell either via the gut (as fæces) or directly via the marginal recurrent ciliary stream (as pseudo fæces) As a single large mussel may thus pass through its body in 24 hours as much as 14 gallons of water, this purifying process is obviously a most powerful factor, and its cleansing action is not aided by the use of water containing active chlorine, because any disinfectant strength of chlorine inhibits or actually arrests the physiological activities of the mussel—thus leading to the retention of bacteria in the mussel body, which would otherwise have extruded them

The practical outcomes of these researches have proved of the utmost value, alike to consumers and purveyors of shellfish and to public health authorities That value lies in the discovery and proof of the fact that there is available a trust worthy, cheap, and simple process, whereby shell-fish—although gathered from polluted estuaries—may be rendered as nearly safe for human consumption as any reasonable authority can require The stages of that process, as regards mussels, for example, are as follows

(*a*) Sea water, pumped into a tank, is sterilised from all germs by adding to it 3 parts per million of active chlorine derived from bleaching powder

(*b*) Any residue of active chlorine remaining after a night's exposure in the tanks having been removed by hyposulphite, the water is then run into other tanks containing mussels spread two-deep upon wooden grids (the mussels having initially been hosed with high pressure fresh water to remove adherent mud) In this sterile, unirritating water, the mussels function perfectly, and eject practically all infective germs from their bodies during the ensuing night

(*c*) The water is then run off, and the ejected mucoid fæces and pseudo fæces are hosed away As an extra precaution, stages (*b*) and (*c*) above are repeated

(*d*) Any germs on the outsides of the shells are removed by exposing the mussels to a bath of water containing active chlorine in solution (3 parts per million)

(*e*) The mussels are loaded into sterilised sacks, which are sealed before dispatch to market with lead seals stamped 'M A F Conway', and bearing the date of dispatch

As thus carried out, this process is so effective that mussels so polluted as to contain 600 sewage germs per cubic centimetre (about a salt spoonful) of their substance, are so purified that this number is reduced in many instances to none, in most cases to less than three, and in almost all to less than five In comparison with the gross bacterial pollution of various articles of food which are con sumed uncooked, such a degree of freedom from germs is truly remarkable, as initiating a new standard of cleanliness for foods

From the business aspect no objections are forth-coming, for the process may be deemed capable of paying for itself on the basis of an output of 8000 bags per annum, and a charge of 1*s* 6*d* per bag of 140 lb of mussels purified, the capital expenditure varying from £3000 to £4500 according to site chosen From the administrative point of view, the working and control have been proved, by some years of trial, capable of being carried out with smooth effectiveness by an adequately trained tank superintendent and one unskilled assistant

This valuable report thus introduces a notable contribution to our means for preservation of the public health, and, as such, will be welcomed by all upon whom that responsible duty falls That, however, is by no means all the story, for, as Dr E S Russell, the Director of Fishery Investigations, observes in his preface "It is significant that the real key to the problem was found in direct and minute observation of the normal physiology of the mussel" Not only has a solution of a difficult practical problem been found by scientific research, but that research has also added a most interesting chapter to our knowledge of molluscan physiology

Perhaps a still more important contribution to

science has been rendered by Dr Dodgson in this comprehensive report by his skilful and courageous criticism (in Part 3) of bacteriological principles and methods of some antiquity and much in need of the caustic consideration which they receive Here again, research and the original discovery that glucose is formed from the tissue glycogen of shellfish pointed the way to criticism of certain bacterioscopic methods depending on the fermentation of lactose, which, though based on perfectly sound general principles, may be quite misleading when applied to the particular case of shellfish analysis But the "cogent evidence" to which Dr Russell refers in respect of this phenomenon and of the errors likely to be introduced by the element of chance in the interpretation of results is as resistant to concentration in a review as it is important from the point of view of the experts It will require an extensive reply from the strictly orthodox

Babylonian Astronomy and Chronology

The Venus Tablets of Ammizaduga a Solution of Babylonian Chronology by Means of the Venus Observations of the First Dynasty By Prof S Langdon and Dr J K Fotheringham With Tables for Computation by Carl Schoch Pp vi + 109 + xvi (London Oxford University Press, 1928) 35s net

THIS is a work of great interest to students both of archæology and of astronomy The story of the many stages that were necessary before a full understanding was reached of the astronomical value of the tablets is as fascinating as a romance The tablets that have come down to us were copies made in the eighth or seventh centuries B C of originals more than a thousand years earlier We are fortunate in possessing a number of different copies of the originals, the calendar dates recorded in duplicate copies are not in perfect agreement, it is a familiar fact both in ancient and modern times that numbers are particularly liable to erroneous transcription We can reasonably ascribe the few discordances that remain in the solution to this cause

The tablets are in the form of omens, stating that such and such configurations of Venus (Nininsi anna is the name used) on given calendar dates will be followed by such and such events on earth *A priori*, such documents would seem void of astronomical value, but convincing reasons have been found for believing that the omens were based on experience, and that such configurations and subsequent events had actually occurred The date of the originals was not even roughly known until Father Kugler announced in 1912 his discovery that a Sumerian phrase that had hitherto been misunderstood meant "The year of the golden throne", and was the date formula of the eighth year of Ammizaduga, commemorating his placing a golden throne and a statue of himself in a Babylonian temple This fixed the date within two centuries or thereabouts, and it was now possible to calculate the positions of Venus for different possible years The fact that transits of Venus usually occur in pairs, separated by 8 years less $2\frac{1}{2}$ days, is well known Any configuration of Venus with respect to the earth recurs after a similar interval of time But when a lunar calendar is used, the recession of the date after 8 years is 4 days, so this calendar is more sensitive than the solar one to a change of date However, an interval of 56 years would bring back the event to the same day of the month, but this would be the month preceding the original one Since the beginning of the year was somewhat elastic in those times, this might bear the same name as the original month, the same thing might even happen after a second period of 56 years, if the dates were given somewhat roughly, or the days of the month wrongly copied, there might be further uncertainty of one or two multiples of 8 years Thus we find that Kugler first adopted the year 1977 B C as the first of Ammizaduga's reign, but later he made it 176 years later in consequence of some arguments of Weidner

Dr Fotheringham then took the matter up at Prof Langdon's request He improved Kugler's calculation in two ways first, by taking into account the accelerations of the sun and Venus which had been found from discussion of ancient eclipses and in other ways, secondly, by noting that the duration of the invisibility of Venus at conjunction with the sun depends on its latitude, which in turn depends on the date in the solar year He reached the date 1921 B C as the first year of Ammizaduga, it is a curious coincidence that the A D date of its first publication was only two years different (1923)

The date 1921 B C is retained in the present publication, and the arguments in its favour have been considerably strengthened With the view of locating the months of the lunar calendar in the solar year, a number of contracts relating to the harvests of corn and of dates have been discussed Kugler made a beginning in this research, but it has been extended Also Herr Schoch devised a

new method, based on the lunar months which were recorded as having had 30 days, this method would not be in itself decisive, but it gives some clue to the actual dates of new moon, it is found to support the above solution Another confirmation is found in the accord between the chronology based on this date and that based on Schoch's identification of the lunar eclipse that preceded the fall of Ur with the one that occurred on Mar 8/9 (Julian) in 2283 B C The record of that eclipse, like the Venus tablets, is in the form of an omen

The book contains a complete chronological list of the kings of Sumer and Accad, Babylonia and Assyria, it combines the deductions from the Weld Blundell prism with those of the present volume It is well to direct attention to the note on p 83 that all the dates of the table before 2300 B C should be made 19 years later, since these had been set up before Schoch's date for the fall of Ur had been adopted Sargon of Agade reigned from 2732 to 2677, and Narâm Sin from 2652 to 2615 Thus Nabu na'id, the last king of Babylon, made an error of some 1100 years in saying that Narâm Sin preceded him by 3200 years

The book also contains discussions on the occurrence of intercalary years, both in Ammizaduga's and neighbouring reigns, these seem to have depended largely on the whim of the monarch There are tables, prepared by C Schoch, for finding approximate positions of the planets, and for obtaining the date of new moon at any epoch between 3500 B C and A D 2000

The full text of the tablets is also given, both in cuneiform and transliterated, with translation and comments by Prof Langdon

A C D CROMMELIN

World History since the War

1918–1928 a Short History of the World By C Delisle Burns Pp 447 (London Victor Gollancz, Ltd, 1928) 16s net

FOR those who desire a compact and trustworthy survey of world history since the War from the political point of view, there is nothing to be had to compare with this book It relies mainly on the much fuller accounts given in the several volumes issued by the Royal Institute of International Affairs, and it adds to them where they have not yet dealt with the particular problem The view suggested is, on the whole, hopeful, and would be more so but for the one serious defect to be mentioned later It points out, for example, the improved stability of Germany since the War "The German Reich is now much more powerful as against any of the local patriotisms of Germany than it was before the war", and again, "whereas the unity of the Russian people was dissolved by the war, that of the German people was confirmed" The real reason for this difference, however, is not hinted at, and it will be found in the defect to be referred to below

There is a wholesome protest, often repeated, against disparaging the increased attention given since the War to the economic aspect of politics "The increase of wealth and decrease of the incidental burden in producing it, is not in the least 'materialistic' The life of the body is the life of the spirit There are not two lives in the common man" The 'common' man, by the way, occurs with rather tiresome iteration and provokes the inquiry who he really is "The neglect of food supply and its incidentals—finance and commerce—by rhetorical politicians and diplomatists is not a sign of their superiority, but of their blindness to the importance of these basic factors on which their own comparative freedom from economic insecurity rests" So far, of course, as these persons do these things, they are open to Mr Delisle Burns's censure But surely they are doing it very little now?

These signs of a somewhat jaundiced eye are trifling and rather interesting blemishes on an excellent piece of work But a word must be said on the really serious point How can anyone, above all anyone of Mr Delisle Burns's knowledge and breadth of mind, offer us "A Short History of the World" without a word on the enormous development and influence of science, and that at a time when its development and influence have been greatest? It is not, as might be urged, a question of limiting the field, for other matters, desirable for a complete view, may be left out without essential damage to the main argument One can write a history of the last ten years without mentioning the poetry and art of the period It would be incomplete, but not vitally mutilated One cannot do so without science, because science is at the base of that shrinkage of the world and that permanent establishment of international relations of which Mr Delisle Burns is as conscious and as firm a defender as anyone To take two crucial examples from the book itself It is because Germany was a scientifically organised and educated country that she survived the War as she did and has increased her coherence, and because Russia was not that she went down, and, on the largest issue which arises in the period, it is because the nations of the West are the guardians of this

scientifically organised society that they must maintain their position vis à vis of the East and the less developed peoples of the globe

It is almost unnecessary to add that these last ten years have also witnessed the most amazing extensions of the scientific spirit above all in astronomy and physics that humanity has ever gained These belong to all mankind they afford the easiest means of binding the nations together and they lift the mind above the atmosphere of jealousy and discord which are so painfully apparent even in a generally hopeful book such as Mr Delisle Burns has given us F S M

Our Bookshelf

Voyages of Exploration to Judge of the Bearing of Hybridisation upon Evolution By J P Lotsy and W A Goodijn 1 *South Africa* (*Genetica Nederlandsch Tijdschrift voor Erfelijkheids en Afstammingsleer* onder redactie von Dr J P Lotsy en Dr H N Kooiman vol 10) Pp viii +315+11 plates ('s Gravenhage Martinus Nijhoff 1928) 35 guilders

DR LOTSY has undertaken during recent years many voyages of exploration seeking evidence of the frequency of hybridisation in Nature in order to assess its rôle in the creation and perpetuation of the diversity in characterisation so abundantly observable Recently with his colleague Dr Goodijn he visited South Africa and in the volume under notice gives an account of the many things they saw The first part of the story concerns itself with forty three plant hybrids distributed over thirteen families

Thereafter the authors turn to a much more interesting topic that of hybrids between different human races so very common in South Africa and yet save for the classical work on the Rehobosh hybrids so far unrecorded The investigation was perforce somewhat hurried and much of that which is written is copied directly from other books which would seem to be mainly impressionistic and uncritical However the chief native races are divided for purposes of discussion into Bantu Bushman and Hottentot linneons and it is suggested that there exist some eight tribes which have had their origin in the crossing of these Quite interesting but definitely anecdotal accounts are given of certain white × black crosses The origin of the de Buys people the Bastaards and Griquas and the Cape coloured is discussed but no really satisfactory conclusion is reached

Finally a number of family histories illustrated with useful photographs is given and these may permit the enthusiast and the expert to identify the ancestry by recognising segregation among the progeny This is always a simple matter in the absence of any standard type Similarly the coloured plates (in a separate folder) illustrating the plant and human crosses are of more artistic than scientific value

Science and Personality (The Terry Lectures) By Dr William Brown Pp ix+258 (London Oxford University Press 1929) 12s 6d net

THIS volume contains the substance of three lectures which were given by Dr Brown in the United States in 1928 and were delivered in connexion with the Dwight H Terry Foundation The material there presented has been amplified by the inclusion of a selection of other papers relevant to the general theme which is broadly a consideration of religion in the light of science and philosophy

Dr Brown commences by a brief survey of the present state of the physical sciences and he then proceeds to examine the condition of the biological and psychological sciences Continuing he deals shortly with the problems of mental unity as contrasted with mental dissociation insisting that here is to be discerned a direct relation to the problems of unity and dissociation in the physical and physiological spheres He then proceeds to consider the various theories which have been advanced to explain the phenomena of suggestion passing on to an examination of the claims of psycho analysis and other forms of psycho therapy The book ends with a discussion of personality in relation to the alleged supernormal phenomena which form the subject matter of psychical research and in this section a full report of a sitting with the medium Mrs Osborne Leonard is printed in order to illustrate the bearing of the trance utterances upon the general question

Although it is obvious that Dr Brown is in favour of trying to reconcile the claims of science with those of religion it is not quite clear in what sense he uses the latter term Again the relation of religion to what he calls the universe and the concept of value which he considers an integral part of his argument are not sufficiently worked out to illustrate the problem of personality and the inclusion of some very dubious examples of clairvoyance towards the close of the volume tends rather to obscure than to clarify the fundamental issues

It is to be hoped that Dr Brown will return to the same theme in another place and develop individual points in his theory more fully than he has found possible in the present volume

Vorlesungen über theoretische Physik an der Universität Leiden Von Prof Dr H A Lorentz Band 4 *Die Relativitätstheorie für gleichförmige Translationen (1910–1912)* Bearbeitet von Dr A D Fokker Ubersetzt von Dr H Stucklen Pp ix+180 (Leipzig Akademische Verlagsgesellschaft m b H 1929) 13 80 gold marks

THIS volume is substantially a translation of the lectures delivered by Prof Lorentz in 1910–12 on what is now called the special theory of relativity with one omission and a few additions The part omitted dealt with gravitation and has been withdrawn as being superseded by Einstein's general theory One addition is an account of later experimental work on the mass of a moving electron The results of Guye and Lavanchy (1916) on

cathode rays of high velocity are described very fully, as they are regarded as removing any possible doubt as to the truth of the Lorentz transformation formulæ Another addition, taken from later lectures, discusses a few specially difficult questions concerning tension, momentum, and energy

The special theory is so well known now that the book calls for little comment The style, as might be expected, is excellent It is characteristic of the author's modesty that he dismisses in a single sentence his own researches which preceded those of Einstein

There is one point in Prof Lorentz's presentation that is rather puzzling On p 17, and again on p 27, he strongly maintains that the contraction of a moving rod is a real effect, and not merely apparent This seems to be in direct conflict with the opinion of Eddington (cf "The Mathematical Theory of Relativity", p 26) On p 28, Prof Lorentz supports his view by saying that the contraction can be photographed This perhaps establishes it as a real effect of the relative motion between the rod and the camera, but scarcely as a real property of the rod itself H T H P

Probability and its Engineering Uses By Dr Thornton C Fry Pp xiv + 476 (London Macmillan and Co, Ltd, 1928) 30s net

UNDER the impact of numerous scientific developments, physical, biological, and engineering, the subject of probability is gradually finding a position of first importance among mathematical studies Beset as it has been with its own natural difficulties and with the conflict of views regarding its foundations held by various sections, no authoritative treatise has so far appeared that has been accepted without question by all sides Many text books on the subject in the past have at best been a mere collection of examples with little or no co ordination The present volume is the result of a course given at the Bell Telephone Company and at the Massachusetts Institute of Technology on the theory of probability as applied to electrical problems, in particular those problems that arise in the work of the telephone exchange Although the book bears clear evidence of its origin, its utility is not in any sense limited to this field, and its applications in numerous directions are to real and useful things

The introductory chapters contain a very sound exposition of the fundamentals of the subject, and the author is at great pains to bring out the circumstances in which the purely abstracted problem of probability may or may not be expected to have its application in the real world In later sections, averages and distribution functions, as they occur most frequently in engineering statistics, physics and actuarial science, are handled with interesting and detailed discussions on traffic density and adjustment of traffic flow, especially in relation to the work of telephone exchanges For physicists a chapter of especial interest is that giving a concise treatment of the kinetic theory of gases, with the numerous applications of probability in that field clearly set out The book is at once clear, bright, readable, instructive, and accurate, and is certainly to be recommended

Vertebrate Zoology an Introduction to the Comparative Anatomy, Embryology and Evolution of Chordate Animals By G R de Beer (Text Books of Animal Biology) Pp xx + 505 (London Sidgwick and Jackson, Ltd, 1928) 15s net

A NUMBER of topics of considerable interest in comparative anatomy and embryology have been dealt with in the researches of recent years, but, despite their importance, they have been slow in finding their way into text books, particularly in the English language The present volume is largely concerned with these, although more generally available conclusions of fundamental importance are also included They are discussed clearly in a series of separate chapters, some of which might be expanded with advantage, and occupy just over a third of the book

The chapters on the embryology of *Amphioxus*, the frog, the chick, and the rabbit as illustrating different types of development, and those on the evolution of the various classes of chordates, are written in an interesting manner The early chapters, giving descriptions of nine different forms, are very brief and will not be of much service to the student although they may help the layman to appreciate the discussions in the subsequent pages Some of the illustrations are not up to the standard that might be expected in a work of this description, and here and there are statements that are ambiguous or incorrect

The book furnishes the general reader with a good review of the present ideas in chordate morphology, and the student of zoology will also find much that is of interest and use to him in his studies

A Study in Tubercle Virus, Polymorphism, and the Treatment of Tuberculosis and Lupus with Oleum allii By Dr William C Minchin Third edition Pp xvi + 110 + 26 plates (London Baillière, Tindall and Cox, 1927) 25s net

THE main thesis of this book is that the bacillar one is not the only form of the tubercle bacillus, and that minute spherical granules are extruded from the bacillus, which undergo a cycle of development consisting of division, budding, and protrusion of tubular structures As regards the granules, the author's observations are probably correct and are confirmatory of those of Spengler, Much, and others, and of the more recent work which suggests that there is a 'filterable' stage of the tubercle bacillus The development cycle seems much more problematical and needs confirmation For the treatment of tuberculous conditions, the author extols an old remedy, oil of garlic, and produces sufficient evidence of its clinical value to suggest that it is worthy of more extended trial The book is illustrated with a number of excellent plates, though it is questionable if the high magnification (×4000 5000) employed in the photomicrographs is of much value, as resolution is not increased thereby and there is some loss in definition

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications*]

Distribution of Temperature in the First 25 Kilometres over the Earth

IT is with much pleasure that I notice in NATURE of June 1, p 834, Dr Ramanathan's amplification and correction of the tropical portion of my diagram of distribution of temperature in a vertical section of the atmosphere of the globe from the summer pole to the winter pole I hope the time is not far distant when some other enterprising meteorologist will render a like service for the polar regions of that diagram It is badly needed

While, however, we are waiting for that amplification, it would be very helpful if Dr Ramanathan would supplement his contribution by additions and corrections within his knowledge to another diagram, namely, that of lines of equal entropy in a similar section which will be found on p 116 of the volume to which he refers

My reason for asking for this particular service is that, in order to deal with the physics of the upper air, the distribution of temperature alone is not sufficient, the corresponding values of pressure come into consideration too, and the best form in which the information about pressure can be conveyed is by a corresponding diagram of isentropic lines which can indeed be superposed without risk of confusion upon the isothermal lines already drawn

In explanation let me say that everybody recognises that convection is a primary feature of weather, and we are accustomed to think of temperature enhanced beyond that of the environment as the natural preliminary to convection So it is, but it is temperature in relation to pressure—entropy, in fact—that really counts It is entropy which decides the equilibrium position of a sample of air, whether it will rise or sink or stop where it is in a particular environment Entropy depends on temperature and pressure It is reduced by reduction of temperature, but enhanced by reduction of pressure in accordance with algebraical formulæ which are quite easy to work, and are set out in the report of the recent Leipzig meeting of the International Commission for the Exploration of the Upper Air The physical significance of an isentropic surface in the atmosphere is that air cannot pass upward from it without access to a supply of heat, nor downward without getting rid of heat Circulation along an isentropic surface on the other hand can take place without any communication of heat, no matter whether the controlling surface be horizontal or vertical at the position of the sample Convective equilibrium is the name which our predecessors gave to an isentropic condition in the vertical, and no energy is required for motion where there is convective equilibrium We are accustomed to think of convective equilibrium as characteristic of a considerable horizontal area, but that can scarcely be so—differences arise from variations in surface temperature, height, or solarisation, and the minutest difference in a region of convective equilibrium is dynamically operative

Hence the lines of equal entropy in a vertical section are a guide to the conditions of the circulation of air and may be regarded as essential to the comprehension of the physics of the atmosphere

Doubtless, in order to deal with particular conditions, diagrams of isentropic surfaces for the particular occasions are necessary, and they can be provided as soon as we can get maps of the distribution of pressure and temperature at successive levels The diagram of normals is not the final step, but it is at least a first stage, and an important one in the prosecution of productive inquiry, I trust that Dr Ramanathan will find an opportunity for providing it Personally, I require the information for tracing possible tracks of air elevated by convection in the tropical regions and descending somewhere else I have a place ready for it, and if he will supply it I shall be correspondingly grateful NAPIER SHAW

10 Moreton Gardens S W 5,
June 3

An Ancient Spearhead

IN the British, London, and Aylesbury Museums are a few iron spearheads, presumably of the Early Iron Age, and evidently copied from the cast bronze spearheads of the late Bronze Age, which ended about 800 B C in Britain All of these were found in England Mr Reginald A Smith, Keeper of British and Medieval Antiquities, British Museum, informs me that their occurrence has long been a mystery, that, on one hand, it is difficult to account for their

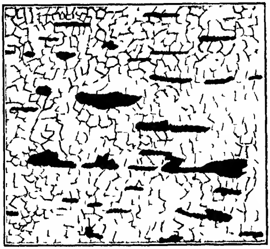

FIG 1

shape in wrought iron by reason of the high degree of technical skill required for their manufacture in this way, and that, on the other hand, cast iron, of which they may possibly be composed, is supposed to have been unknown even in medieval times

I was recently approached by him to know whether it would be possible to put this matter to the test, and a specimen in the British Museum from Golden Lane, City of London, was selected for this purpose, The weapon in question is a narrow leaf shaped spearhead of Bronze Age type, 7½ inches in length, having a short round socket with flattened sides which are pierced by two holes for a rivet The blade has a mid rib extending to the tip, and inside the socket tapers for a length of 5¼ inches Its approximate date is 7th century B C It may be a century or two later, but scarcely earlier

There was no difficulty about preparing a surface suitable for microscopic examination, although owing to the regulations the specimen itself could not be taken out of the Museum, and the necessary work had to be done there For this reason it was not

possible to photograph the actual structure obtained The section examined was parallel to the surface of the spearhead and about half way between the tip and the broadest point A sketch of the microstructure was made with great care by my assistant, Dr J M Robertson, and from this the accompanying photograph (Fig 1) was prepared The structure shown is at a magnification of 120 diameters It is typical of wrought iron The black elongated areas with somewhat serrated and rough edges represent the slag threads which have been elongated in the direction of working The small irregularly shaped polyhedra are the crystals of iron There is no doubt, therefore, that this particular spearhead consists of wrought iron, and not of cast iron

Without a complete examination and consequent destruction of the spearhead, it is impossible to ascertain how the forging was done, but there are certain features of the specimen itself which suggest two possible methods of forming The hollow centre of the rib extends to within a short distance of the point of the spear and tapers with the rib so that the metal of the rib is of approximately the same thickness throughout its length It would appear that this hollow in the rib is a consequence rather than an object of the method of forging, and it indicates that the forming was carried out on a mandril of metal or stone Two alternative methods of forming may be considered In the first the spear head could have been made from a long strip bent back over the mandril and forged down at a welding heat In this way the head would be formed from one piece of metal, the leaf shape would be obtained by chipping or grinding, the joints would correspond with the edge of the spear and a mandril would be necessary to form the central rib In the second, the mandril may have been used to pierce a billet of suitable size and have served as a means of holding the metal during forging and as an aid in forming the rib

Whatever method of forging was in fact adopted, the crystal structure of this spearhead is very similar to that of a wrought iron produced at the present time It is impossible not to admire the skill of the earliest iron workers who produced results such as this

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The Dehydration of Benzene

PROF H B BAKER has shown that prolonged contact between benzene and phosphorus pentoxide results in a marked rise in the boiling point of the liquid From this we may safely infer that corresponding and concurrent variations in other physical properties, such as the refractivity, freezing point, and specific volume, take place during the process of dehydration

To test the accuracy of this supposition, I have during the past year carried out many determinations of the refractivity of benzene in the presence of pure phosphorus pentoxide For this purpose use was made of (a) a hollow prism and refractometer readable to 1" of arc, and (b) a Jamin interferometer by Hilger capable of measuring to within $\frac{1}{4}$th of a fringe For each series of experiments the benzene bought as 'pure' was re purified and subjected to a preliminary drying by calcium chloride

After introducing the benzene into the prism or interferometer, a first determination of the refractivity was made Pure phosphorus pentoxide was then placed in the liquid, and additional and periodic measurements of the refractivity effected Data thus obtained during an interval approximating six months, proved that as a result of exposing the benzene to the action of the dehydrating reagent the refractivity changed continuously On plotting refractivities against time, the resultant graph consisted of two distinct portions or limbs, both smooth, but having very different directional values A study of the whole graph has led to the conclusion that the first limb represents the rate of the removal of the mechanically admixed water, and that the second limb offers a measure of the rate of the withdrawal of water in actual combination with benzene In other words, the first limb of the graph is indicative of the rate of drying as ordinarily understood, and the second the rate of true dehydration Whence it appears that during my experiments the benzene under observation behaved as does a wet crystallised salt, such as copper sulphate when exposed to air

The results so far obtained clearly indicate that, within some as yet undetermined range of temperature, benzene firmly combines with water, and thus forms one or more hydrates This conclusion is strengthened in consequence of some preliminary measurements of the specific volume of benzene in the presence of phosphorus pentoxide This physical 'constant' is found to be dependent upon the temperature to which the benzene has been exposed *immediately before* the determination is carried out For example, I find that the normal specific volume at 18° C is lessened by a preliminary cooling of the benzene in melting ice, and increased when the liquid is first heated to 21° C Whence it appears, first, that during crystallisation, combined water is ejected from the benzene and taken up by the phosphorus pentoxide, and secondly, as the temperature is raised from 0° to 21° C, the process of dehydration is reversed so that the benzene is re hydrated by the withdrawal of water from the newly formed metaphosphoric acid From this it follows that the drying power of anhydrous benzene is, within certain limits of temperature, greater than that of phosphorus pentoxide

During precisely similar experiments conducted with benzene in the absence of phosphorus pentoxide, the changes in the specific volume, although in kind the same, were relatively quite insignificant

These investigations are being extended, and in due time I hope to give a detailed account of the work elsewhere

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The Intensive Drying of Liquids

THE well known work of Prof H B Baker on the properties of liquids and solids which have stood for long periods of time in closed vessels with phosphorus pentoxide is of the greatest importance to chemists Since the publication of Prof Baker's 1922 paper, in which he reported a remarkable change in some of the physical properties of ten liquids which had been dried for from eight and one half to twenty eight years with phosphorus pentoxide, the problem of the influence of traces of water on pure chemical substances has been of controversial interest Several authors have described experiments which are interpreted as confirming Prof Baker's work (Smits, *J Chem Soc*, **125**, 1068, 1924 Mali, *Z anorg Chem*, **149**, 150, 1925 J W Smith, *J Chem Soc*, 867, 1928), while I have not been able to check this work (Lenher and Daniels, *Proc Nat Acad*, **14**, 606, 1928) with benzene and carbon tetrachloride which had been dried for from four to four and one half years (1923–1928) The difficulties of repeating Prof Baker's experiments are very great, because

experiments carried out in a drying time less than that taken by him, which do not effect a change in the dried liquids, can always be met with the practically unanswerable criticism that intensive drying had not been obtained

I have no reason to believe that the liquids described by me in the *Proceedings of the National Academy of Sciences* were not intensively dried In fact, if one accepts the work of Smits (loc cit) the liquids which were sealed up with phosphorus pentoxide in 1923, and were examined in 1928 by me, were certainly intensively dried, though no change in the physical properties of these liquids was observed As I could see no explanation of my results other than the obvious conclusion that the boiling point of dried liquids and undried liquids is the same when superheating is effectively prevented, there remained the difficulty of explaining Prof Baker's remarkable results Experiments were performed to see if the effects reported by him could not be obtained under similar experimental conditions with ordinary liquids These experiments, a full description of which will be published shortly in America, show that ordinary pure benzene carbon tetrachloride, and water give apparent boiling points as high as 27° above the normal boiling point when measurements are carried out in a reproduction of the apparatus described by Prof Baker and Prof Smits I have repeated the crucial experiment of Baker and Smits (Smits, loc cit , Baker, *J Chem Soc*, **123**, 1223, 1923) with exactly the apparatus and procedure described by them, using ordinary benzene, and I have observed the same phenomena There can be no doubt that what is interpreted by these authors as a fractional distillation of dried benzene is superheating of benzene, for the same effect is obtained with ordinary pure benzene

The conditions which are favourable to this apparent rise in boiling point have been studied and will be described at length elsewhere Some of these conditions are (1) the use of a heating bath (2) the immersion of the thermometer bulb in the liquid the boiling point of which is being measured (3) allowing a liquid to stand in contact with a flocculent solid, such as redistilled phosphorus pentoxide, which will remove dust particles (Spring, *Rec Trav Chim Pays Bas*, **18**, 233, 1899), and (4) distillation of the liquid into a clean flask before determining the boiling point, which tends to free the liquid of dust particles which act as centres for the formation of bubbles to initiate boiling (Martin, *J Phys Chem*, **24**, 478, 1920)

I have repeated and extended Prof Baker's experiments on benzene which has been subjected to a high direct current potential (*J Chem Soc*, 1054, 1928) The boiling point of benzene subjected to a potential of 450 volts direct current for more than twenty four hours in a reproduction of Prof Baker's apparatus was found to be unchanged, namely, 80° to 80 2°, when heating was carried out with a platinum wire heating element under conditions where it is known there is less than 0 03° of superheating When boiling point determinations were carried out both on benzene subjected to the direct current potential and ordinary benzene with no potential applied in an identical apparatus, using a heating bath (Prof Baker seems to use a heating bath in his boiling point determinations), no difference which could be attributed to the influence of the potential was observed, both tubes were easily heated 10° to 25° above the boiling point of benzene before ebullition began One is forced to conclude not only that there is no real change in the state of liquids subjected to a high direct current potential, but also that the original measurements were carried out under conditions where superheating is practically unavoidable

It does not seem necessary here to consider the theories of Prof Baker and Prof Smits on the intensive drying of substances, but this matter, together with additional experiments and a review of the published evidence for the change of some of the physical properties of liquids on prolonged drying, will be dealt with in the forthcoming paper referred to above

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X-ray Evidence for Intermolecular Forces in Liquids

DIFFERENT mathematical methods[1-5] have been used to express the conception of the 'structure of a liquid' in exact formulæ, mainly with the intention of accounting for the X ray diffraction pattern The different treatments, however, have a common principle, which for our purpose may be stated in the following way The arrangement of the molecules in the liquid, and of the electrons in the molecules, causes a non uniform distribution of scattering power in the liquid This distribution may be resolved in a continuous range of periods in a way analogous to, but not identical with, ordinary Fourier analysis In X ray terminology these periods may be called 'spacings', if properly defined each of them is related to a certain diffraction angle by the well known Bragg relation, and their strength is measured by the corresponding intensity in the diffraction pattern

We will confine ourselves to molecules which do not differ *very* much in shape from spheres Then the most prominent spacing is due to the mutual distance of neighbouring molecules, and it is indeed this spacing which accounts in most cases for the 'principal halo', as has been put on firm ground for the first time by an experimental study of Keesom[1]

The interpretation of the diffraction pattern *outside* the principal halo is complicated by the fact that here the 'inner structure' of the molecule, mentioned above, may also play a part On the contrary, I wish to emphasise that this influence must be negligible in the region of the pattern *inside* the principal halo This arises from the fact that if the inner structure is resolved into 'spacings', these are of course mainly shorter than the intermolecular distances Therefore it may be stated that *the diffraction pattern of liquids inside the principal halo is only related to the mutual arrangement of the molecules*

This circumstance suggests the possibility of applying some theoretical considerations First, it has been shown[3,4] that for the case of *very* small diffraction angles the intensity must approach a definite limiting value, which may be calculated from the compressibility of the liquid, and is ordinarily about five per cent or less of the intensity that would result if the scattering of all molecules were incoherent But we may perhaps go a little further, at least when the intermolecular forces may be neglected (except of course in so far as they prescribe a definite volume for a definite quantity of molecules) To this end we compare our problem with the analogous one-dimensional case,[4] where the required calculations are easily carried out rigorously, and show that, when we proceed

[1] W H Keesom and J de Smedt, *Proc Amsterdam*, **25**, 188, 1922 W H Keesom, *Proc Amsterdam*, **30**, 341, 1927

[2] C V Raman and K R Ramanathan *Proc Ind Assoc for Cultiv Science*, **8**, ii 127, 1923

[3] P Debye *Jour of Math and Phys*, Massachusetts, **4**, 133, 1925, and *Phys Zeitschrift*, **28**, 135, 1927

[4] F Zernike und J A Prins, *Zeitschr f Phys*, **41**, 184, 1927

[5] G W Stewart, *Phys Rev*, **32**, 558 1928

from the principal maximum to smaller angles the intensity falls off continuously and rather rapidly to the limiting value already mentioned There is no reason to suppose that this should be radically different in three dimensions

With the view of testing these points I have recently examined the diffraction pattern of many liquids at small diffraction angles and have arrived at some results that seem interesting enough to communicate to NATURE As an example let us take water (here it is chiefly the arrangement of the oxygen atoms that determines the diffraction pattern) It is well known that the principal halo of water lies at a diffraction angle to which corresponds a spacing of about 3 A, in good agreement with the mean intermolecular distance I have found however that at the inner side of this halo the intensity is rather strong and roughly constant till a very small angle is reached, corresponding to a spacing of about 17 A At this angle the intensity falls off rapidly, and for still smaller angles approaches a limiting value which may be assumed with some reason to agree with the theoretical limiting value considered above But how are the spacings between 3 and 17 A to be explained? We have already seen that we certainly must look for an explanation in the arrangement of the molecules A closer examination shows that this arrangement must be of the following kind in the immediate neighbourhood of every molecule the mean density must be greater than at greater distances This arrangement may be described as a 'tendency to association' though I think this is mostly to be understood in a dynamical rather than in a statical sense The reason of this arrangement is, of course, to be found in the nature of the attractive intermolecular forces

The same strong scattering inside the principal halo is found with many other liquids, and recently it has also been remarked by Krishnamurti [6] that with liquids classified from other reasons as 'associating' it is often so strong as to give rise to an 'inner ring' This agrees with the explanation given above

I should like, however, to point out, that a scattering inside the principal halo, stronger than the limiting value, though much weaker than in the previous cases, is present also with liquids, as benzene, carbon tetrachloride, carbon bisulfide, and others,[7] which are usually not called 'associating' Indeed the only exception known to me is that of mercury From this it would seem that in the X ray pattern we have a much more sensitive method for studying the intermolecular forces than in many other methods Perhaps we may hope in due time to be able to draw more definite conclusions from it In this respect it might even sometimes serve us better than the diffraction pattern of the solid state

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X-ray Pattern of Metallic Crystals

WHILE reading the literature on diffraction of X rays, I came across interesting photographs of X ray patterns for a few metallic foils—aluminium, cadmium, copper, lead, silver, thallium, tin, zinc, and several kinds of brass—at different temperatures (Nishikawa and G Asahara, *Phys Rev*, 1920) The most interesting fact one finds from this paper is that there is a remarkable change in the nature of the pattern for a metal as time elapses after the rolling process Silver and tin for example gave ill defined patterns immediately after the rolling process, but these gradually changed during the following two or three weeks to the distinct spot patterns characteristic of annealed samples Nishikawa and Asahara conclude from this that for these samples the crystal growth which accompanies anneal ing takes place at room temperatures

We had in our laboratory a few metal foils kept at room temperature for about twenty years This is indeed a sufficient time for the complete recovery of the foils after the process of their production, and a beautiful spot pattern was expected Patterns for a few metallic foils were therefore taken For this purpose a Hadding tube with a copper anticathode was worked at about 85 kv and 10 ma A strong beam of X rays was allowed to pass through the material The pattern was recorded on a photographic plate kept at a distance of 3 cm from the leaf Silver and gold gave a ring pattern the rings were quite continuous and there was no indication of any spots on the plate In the case of tin (grey) the pattern was mostly similar to No 27 of Plate 1 of the paper quoted above and not spots as in No 27 For gold and silver the rings were not only of similar nature but were also of identical diameter The diameter of the inner ring was 3 7 cm, and that of the outer one 4 5 cm The intensity of the inner ring was about ten times the intensity of the outer one From these facts one is tempted to draw the following conclusions

(*a*) For silver and gold the lattice is the same, and is the same in magnitude This is borne out by the experiments made by 1 Vegard in a different way (*Phil Mag*, 32, 1920) (*b*) These metals do not recover from the effects of the process by which the leaves are made using the terminology of Nishikawa and Asahara (*c*) It is more proper to regard a thin metal leaf as an assemblage of metallic crystals as in the case of powders, for which by Hull's method we always get a ring pattern

Taking d as the lattice constant responsible for the production of both the rings, we find that $\sin\theta/\sin\theta = 0\ 87$, which is about the same as $Cu(K\beta)/Cu(K\alpha)$ It thus appears that the two rings are due to $K\beta$ and $K\alpha$ lines of copper

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Emission Lines in the Spectrum of the Solar Corona

IT seems very improbable that the bright line spectrum of the inner corona can be attributed to thermal excitation of the coronal matter We may seek its cause in the process of photoelectric ionisation and apply then, as a first and rough estimate of its brightness, the same analysis as Dr Zanstra has done in the case of diffuse nebulæ (*Astrophys Jour*, 65, No 1) Thus we assume in this approximation that the emission spectrum of the corona is due to a mechanism of recombination of free electrons with atoms, ionised by the high quantum radiation, emerging from the sun, acting as a black body radiator, and that the corona consists only of monoatomic hydrogen We have to suppose, further, that the high quantum radiation is completely absorbed by the coronal material, and that all the freed electrons recombine with the ionised hydrogen atoms

[6] P Krishnamurti, *Ind Jour Phys* Calcutta 2, 491 1928 In another paper Mr Krishnamurti has also studied solutions from the same point of view as I did in a previous letter to NATURE (*Ind Jour Phys*, Calcutta, 3, 209, 1928, NATURE 123, 84, 1929)

[7] As a curious fact it may be mentioned that organic iodides seem to show an inner ring while bromides do not, even if the molecules are rather long (for example, C_{16}-dibromide) For the longest spacing of C_{16}-dibromide in solid state I found 12 6 A, this low value probably indicates that the CH_2-chain is not straight in this compound

With these assumptions we can apply Zanstra's formula for the ratio of the integral brightness of the corona to that of the sun

$$L \sim \int_{x_0}^{\infty} \frac{x^2}{e^x - 1} dx \Big/ \int_{x_1}^{x_2} \frac{x^2}{e^x - 1} dx, \quad x = \frac{h\nu}{kT},$$

where T is the sun's effective temperature, h and k are well known constants ν_0 will be in our case the frequency corresponding to the head of the Lyman series ($32\ 84 \times 10^{14}$), ν_1 and ν_2 are the limits of frequency for photographic rays ($\nu_1 = 5\ 95 \times 10^{14}$ and $\nu_2 = 9\ 10 \times 10^{14}$) Expressing L in differences of stellar magnitudes Δm we get

T	Δm	m
6400	18 0	8 0
6200	99 1	6 9
6000	20 0	- 6 0
5800	20 8	- 5 2

(m_c is stellar magnitude of the corona, $m = -26\ 0$ mag)

We can conclude from these data that even in the case of lowest admissible effective sun's temperature, we should obtain on the plates the effect of a relatively faint but characteristic bright line spectrum superposed on the continuous spectrum of the corona (Russell Dugan, Stewart, Astronomy, vol 2, p 507)

It should be noted that the proposed explanation of the bright coronal lines is related to a fact noticed by Balanovsky and Perepelkin (*Mon Not Roy Ast Soc*, **88**, p 747), namely, that the coronal material seems to be attracted by the solar prominences This may be due to the fact that a part of the high frequency quanta, being absorbed by the prominence, does not reach the coronal matter and produces a darkening of the corona over the prominences In that case the coronal emission lines ought to weaken considerably above a prominence, and such an effect, if observed during an eclipse, would afford a proof of the photoelectric origin of the coronal emission spectrum

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W NIKONOW

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Growth-gradients and the Axial Relations of the Body

IN previous communications (see Huxley, 1927, *Biol Zentralbl*, **47**, 151) it has been pointed out that in Crustacea the presence of a centre of active growth, for example, in a male chela, is associated with excess growth of the other walking legs The third maxilliped, however, is not affected in this way, but appears to be slightly decreased in the male The question arose whether this was a positional effect, appendages anterior to the growth centre being inhibited in their growth those posterior being accelerated, or whether, since the maxilliped was an appendage of different type from the pereiopods, its growth was not correlated with theirs

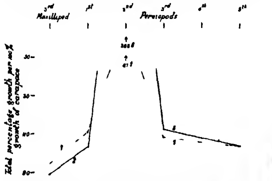

FIG 1—Amount of growth in length per 100 per cent growth of carapace length in male and female prawns (*Palæmon carcinus*)

To settle this question, measurements have been made on a large Indian species of *Palæmon* (*P carcinus*) in which the second pereiopod, not the first, is enlarged as the male chela The material was presented by the Zoological Survey of India through the kindness of Col Seymour Sewell

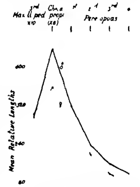

FIG 2 Relative lengths (in per cent of carapace length) of male and female spider crabs (*Inachus dorsettensis*) After M E Shaw *Brit Jour Exper Biol* **6**, 145

The results appear quite definite For 100 per cent increase in carapace length the percentage increase in length of the various limbs measured are as follows

Maxilliped	Pereiopod				
3rd	1st	2nd	3rd	4th	5th
♂ 89 0	103 2	265 0	112 2	107 8	103 2
♀ 94 6	111 1	167 0	108 1	105 2	103 1

The accompanying diagram (Fig 1) shows the results graphically Fig 2 shows the effect in *Inachus*, where the first pereiopod is the large chela Other methods of analysing the figures confirm this conclusion, namely, that exceptionally active growth in one appendage is correlated with a slight acceleration of growth in the appendages posterior to it, a slight retardation in those anterior

It has previously been established that the heterogonic growth of an appendage takes place most rapidly in a 'growth centre' near its tip, and that there is a 'growth gradient' down from this region towards the trunk It would thus appear that when the local growth gradient of the appendage reaches the trunk, it is influenced by the axial relations of the whole animal, and affects the regions posterior to the appendage in a different way from those anterior to it No view has as yet been put forward as to the mechanism of this influence, and we should welcome any suggestions bearing upon it

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Growth and Longevity of Whales

ACCORDING to Mr N A Macintosh (British Association Report, 1928) Blue whales and Fin whales grow quickly and probably reach maturity in the short space of two years, Mr Macintosh's statement implies that, in favourable circumstances, these great animals might increase in number fairly quickly, but that they die without attaining any great age

In the case of the Greenland whale the duration of gestation and lactation are unknown, but the following facts suggest that it takes more than two years to reach maturity, that it multiplies very slowly, but that it attains a considerable age

1 So far as can be ascertained now, the Greenland

whale is 14 or 15 feet long at birth, is about 20 feet long and its whale bone less than 2 feet long when it is weaned, but is not sexually mature until its length is about 50 feet and its whale bone exceeds 10 feet.

2. As stated in my letter on the "Extermination of Whales" (NATURE, Mar. 2) in the Greenland Sea in the period 1860–1909, only a small number were killed by the whalers, including those that may have died after breaking loose, two or three less than ten a year, and that notwithstanding this small mortality at the hands of their human enemies in those years they showed no signs of increase. It might be objected that the whalers were not the only enemies of the Greenland whale and that others came to an untimely end in other ways, but of this there is no evidence. In the Greenland Sea the Killer whale, its most likely enemy, is not found amongst the ice, and as far as I saw the whales do not appear to suffer or die from disease. Only those that died from harpoon wounds were found floating dead.

3. Harpoons were sometimes found in whales, which the animals appear to have carried about buried in them for a long time.

In the Greenland Sea, in 1863, my father killed a large whale in which he found an old harpoon marked 'Pow and Fawcus, Newcastle, 1839', and in 1872 he killed two others, also large, in each of which he found old harpoons (Buckland's "Log book of a Fisherman", etc., p. 247).

In Davis Strait in 1894 the *Terra Nova* killed a large whale (12 feet bone), in the blubber of which was found embedded a harpoon bearing the name 'Jean of Bo'ness', and dated forty years back. The *Jean*—a well known whaling ship—was lost in Davis Strait in 1857 (*Zoologist*, 1895, p. 94).

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Reduced Flowers of *Ranunculus*

I AM glad my letter to NATURE (April 13, p. 568) has been the means of eliciting from Mr. Marsden Jones and Dr. Turrill a very interesting joint communication (NATURE, May 25, p. 798) on the above subject. I hope I have not unwittingly been attempting to steal their thunder!

The references to the literature they give are very welcome. Apparently these buttercup plants with reduced (female) flowers have hitherto failed to interest British field botanists—an instance perhaps of the lack of sympathetic feeling and co-operation between the systematists and the geneticists.

As yet I have not come across in this district the reduced form of *Ranunculus bulbosus*, but shall keep my eyes open now that the buttercup season is with us. Plants of *R. acris* with the small flowers and aborted stamens are appearing as usual.

If there be evolutionary significance in these reduced flowers, then seeing there are all grades between plants with completely hermaphrodite flowers and those with no functional stamens, it looks as if there is here an example in support of the view of "the inevitability of gradualness" (to adopt a famous phrase used in another connexion) in evolution.

The writers of the joint letter express surprise at my not mentioning a freak plant of *Ranunculus acris* I found here in the middle of a pasture field a few years ago. Reference to such a plant did not appear germane to the subject matter of my former letter, for I regard it as a sport which has no bearing on the evolutionary trend of the species. Others naturally may take a different view. It is pleasing, however, to know that it is of value to these workers on the genetics of the genus, especially as they have proved it to be functionally male only—a point which was not obvious to me at the time of its discovery. The original plant is still in the garden here. It does not grow nearly as strongly as the ordinary or reduced (female) form of *Ranunculus acris*; consequently in the wild state it might soon have failed to hold its own and been squeezed out of existence. It was a frail affair when I lifted it from the pasture. A feature of it not mentioned in the Marsden-Turrill letter is the distinctive character of its foliage. The leaves are somewhat crested and less sharply cut than those of the type, so that the plant can readily be recognised when not in flower.

J. PARKIN.

Blaithwaite,
Wigton, Cumberland,
May 29.

Nervous Impulse in *Mimosa pudica*

IN a letter under the above heading (NATURE, April 13, 1929) Prof. Hans Molisch describes certain experiments which appear to confirm the earlier work of Sir J. C. Bose. Space does not permit of a full discussion of these results, but it is rather surprising to find that Prof. Molisch regards the experiment of Bose on the supposed reflex arc as satisfactory evidence, since the fallacy in this experiment has already been demonstrated by K. Umrath (*Planta*, 5, 1928, p. 295, footnote).

As Umrath points out, and as I also have found, the serial reactions of the pinnæ take place in the same way, whether one stimulates a pinna of a leaf attached to a shoot or one from which the main pulvinus has been removed. This fact disposes of the contention that an afferent impulse is changed into an efferent one in the main pulvinus. Further, neither Sir J. C. Bose nor Prof. Molisch mentions the reactions of the secondary pulvini. I have noticed that if one stimulates one pinna, either electrically or by cutting, in the large majority of cases the secondary pulvini of the other pinnæ react *before* the main pulvinus, thus showing that the excitation has already reached them. As Umrath points out, there is a delay in the transmission between the secondary pulvinus and the basal pair of pinnules. This delay allows time for the excitation to reach the main pulvinus, which thus reacts before the excitation is apparent in the pinnules on the unstimulated secondary petioles.

Occasionally I have observed the excitation beginning to pass up the unstimulated pinnæ before the main pulvinus reacts, but usually the time which has elapsed is not sufficient for it to pass beyond the secondary pulvini.

It is therefore apparent the transition of the excitation from one pinna to another takes place at the apex of the petiole and not through a reflex arc passing through the main pulvinus.

NIGEL G. BALL.

Ceylon University College,
Colombo, May 7.

The Ratio of the Mass of the Proton to that of the Electron

IN a recent paper (*Proc. Roy. Soc.*, 122, p. 358, 1929) Prof. A. S. Eddington reached the conclusion that the value of the physical constant $ch/2\pi e^2$ is given by the integer 136. His theory reduces the evaluation of this constant essentially to the counting up of symmetrical elements in a square array. The numbers

of such elements in arrays arising in this connexion are 10, 136, etc

In this light, it is interesting to speculate if at least some of the dissimilarities between the proton and the electron are not somehow bound up with the question of degrees of freedom, and, in particular, if another important non dimensional physical constant, namely, the ratio of the mass of the proton to that of the electron, M/m, cannot be accounted for by counting up elements and by performing simple operations with the numbers so obtained If so, it is plausible to assume that M/m should depend on two such numbers, one of them being 136 The other number here taken is 10, as the absence of protonic spin hints at the smaller value With these two integers on hand, and with the observed value of M/m (1840, roughly) in mind, it is tempting to write

$$\frac{M}{m} = \frac{(136)^2}{10} = 1849\ 6$$

I am aware of no proof of this relation But as I do not, at present know of any reason for ascribing the numerical result, without at least some hesitation, to a mere coincidence, I believe that the numerical agreement in this empirical relation warrants notice

V ROJANSKY

Washington University,
St Louis U S A ,
April 26

Freshwater Medusæ in England

IN NATURE for Jan 12, Prof Hickson has recorded freshwater medusæ and their polyps from Mr V B Poulton's aquarium at Boscombe Afterwards these were assigned to *Craspedacusta sowerbii* after comparison with drawings made at the British Museum of polyp stages of that species found last summer on *Pandanus* roots in the *Victoria regia* tank of the Royal Botanic Society and exhibited at a meeting of the Zoological Society

The Boscombe polyps afford additional confirmation of the evidence for linking Sir Ray Lankester's Regent's Park medusa with the polyps of Bourne, Parsons, and Fowler, since they bear medusa buds

In case any other amateur should observe freshwater medusæ in England it is to be hoped that it will occur to him to communicate with the British Museum It seems highly probable that *Craspedacusta* occurs in a wild state in British river systems, and it would be well if a sharp look out for it were maintained

A K TOTTON

British Museum (Natural History),
London, S W 7, May 13

The Crystal Structure of Nickel Films

FILMS of nickel deposited on rock salt by sputtering in residual gas or argon, show an unexpected structure on removal from the rocksalt and examination by the cathode ray diffraction method As is well known, the normal structure of nickel is face centred cubic, as found both by X-ray and electron diffraction methods The new structure turns out to be hexagonal, the values of the axes being $c = 4\ 06$ A , $a = 2\ 474$ A ratio 1 64, which is near enough to the ratio 1 633 for closest packing Nickel thus resembles cobalt in crystallising in both cubic and hexagonal closest packing The density calculated from the above axes is 8 86, in good agreement with that of the metal in bulk The structure is thus different from an hexagonal form found by Bredig and Allolio (*Zeit f Phys Chem* , **126**, p 53, 1927) by spluttering in hydrogen The latter had a density of only 7 04 and is probably a hydride The above is, I believe, the first case of a new crystal form found by electron diffraction

G P THOMSON

University of Aberdeen,
May 31

A Proposed Survey of the Burnet-moths

I AM at present undertaking a survey of the variations in the male and female genitalia and in the wing patterns in the genus *Zygæna*, or Burnet moths This necessitates the collection of specimens from as many parts as possible of the British Isles and continent of Europe I should therefore be very grateful if specimens could be sent to me this summer They should be taken *in pupa* and, if possible at least two dozen from one locality or colony It is very necessary that pupæ from neighbouring or different colonies should be kept separate Details as to the position and extent of the colonies would be welcome so that they can be identified afterwards on Survey maps Pupæ may be taken on the grass stems, packed in a small box and sent to the address below Due acknowledgments to the collectors will be made of course in resulting publications

H R HEWER

Department of Zoology,
Imperial College of Science and Technology,
South Kensington, London,
S W 7

The Emission of Positive Ions from Metals

DURING the study by me of critical potentials in metallic vapours (*Phys Rev* , August 1928), it was noticed that positive ions were given off by heated metals and that these ions persisted for very long periods of heat treatment A determination of e/m of the positive ions from heated metals gives the following results Copper, iron, nickel, and platinum when heated, give alkaline ions only, as has been found by other observers Tungsten, molybdenum, and tantalum when heated to a temperature where vaporisation becomes appreciable, give ions the atomic weights of which agree with that of the metal emitting them Other metals are under investigation

H B WAHLIN

University of Wisconsin,
Madison, Wisconsin, U S A

Adder or Nether

IN his note upon dragonflies in NATURE of June 1, Dr Tillyard asks whether the adder is still called the 'ether' in any part of England I cannot answer for England, but 'nether' is good Lowland Scots for 'adder', and is given in that sense in Jamieson's "Dictionary of the Scottish Language" Among examples given by Skeat of initial *n* shifting from the noun to the indefinite article, or from the article to the noun, he mentions *addere* and *naddere* as interchangeable forms in Middle English , but he says nothing on the question whether 'adder' comes from Anglo Saxon neoðera, nether—the lowly one

HERBERT MAXWELL.

Monreith, Wigtownshire

The Hormones of the Sexual Glands.

RECENT work on the internal secretions of the gonads illustrates the fact that progress is only rapid when a simple specific test for the principle under investigation is available The earlier reports of the isolation of an ovarian hormone failed to arouse the interest of more than a few workers, since the test of activity used, the growth of the female genital tract following injection of the extract into an immature or adult normal animal, was liable to the fallacy that such growth might have occurred naturally, whilst even in spayed animals the end point of the reaction was indefinite in either case the test animal must be killed

The discovery by Stockard and Papanicolaou that the particular stage of the œstrous cycle in a living guinea pig could be easily determined by taking a smear of the vaginal contents was soon applied by Long and Evans and by Allen to the rat and mouse, and the method of following the activity of ovarian extracts by observing the appearance of œstrus after injection of the preparation under test in ovariectomised animals by means of the vaginal smear technique was quickly developed In the case of testicular extracts no such simple test is available, with the result that our knowledge of the hormones of the ovary, incomplete though it is, is in a much more advanced state than that of the secretions of the testis

THE OVARY

A very good review of the physiology of ovarian activity has been given by A S Parkes (*Biol Reviews*, vol 3, p 208, 1928), to which those interested in this subject may be referred At the present time opinion generally favours the view that the ovary secretes at least three different hormones, one controls the development of the secondary sex organs, the uterus, vagina, etc, before puberty, one is responsible for the œstrous symptoms, whilst the third is secreted by the cells of the corpus luteum

It is possible that the prepubertal growth of the secondary organs is due to the secretion of the œstrus producing hormone, a view, however, which presupposes an abrupt change in its mode of action at puberty On the other hand, the œstrous reaction of ovariectomised animals following an injection of 'œstrin' appears incomplete, in that copulation is only infrequently observed, and in the spayed bitch the hormone only produces symptoms of pro œstrus, so that possibly the missing factor may be the hormone responsible for the initial development of the accessory sex organs The cause of the first œstrus at puberty appears to lie outside the ovary, and recent work suggests that a hormone from the anterior lobe of the pituitary gland is concerned both in stimulating the first œstrus and maintaining the regularity of the œstrous cycle However, since injection of an extract of a young male pituitary will produce œstrus in an immature female with intact ovaries, the actual reason for the sudden development of œstrus at puberty still remains obscure

By far the greater amount of recent work has been devoted to the extraction and physiology of the œstrus producing hormone or 'œstrin,' as Parkes and Bellerby have named it At present two widely different methods of extraction have been utilised, resulting in the production of the hormone in an oil soluble or water soluble state In the first method fat solvents are used for the extraction thus the minced ovaries may be thoroughly extracted with alcohol, the filtrates concentrated to a small bulk again taken up in alcohol, filtered, and set aside for the separation of fats and cholesterol The filtrate is then taken to dryness, dissolved in ether and lipoids precipitated by addition of acetone (F Dickens, E C Dodds, and S Wright, *Biochem Jour*, vol 19, p 853 1925) Material obtained by such a process is a brownish oil, soluble in fat solvents and thermostable the activity remains in solution when sterols are precipitated by digitonin A dose of about 1 10 mgm is necessary to produce œstrus in 50 per cent of a series of ovariectomised rats

A variety of methods has been used to obtain the hormone in a water soluble form Dodds has obtained it in the form of a hydrochloride by extracting minced ovaries with picric acid and acetone or minced placenta with hot hydrochloric acid and precipitating the picrate in the filtrate, the picrates being converted into hydrochlorides by solution in acid alcohol followed by precipitation of the hydrochloride by acetone the material thus obtained is of about the same activity as that extracted by the use of fat solvents More recently the same investigator has described a method for obtaining the water soluble hormone in a purer state (H Allan, F Dickens, E C Dodds, and F O Howitt, *Biochem Jour*, vol 22, p 1526, 1928) Placenta is used as source rather than ovary it is heated with baryta and the filtrate concentrated and extracted with butyl alcohol by shaking the extract is evaporated under reduced pressure almost to dryness, and the residue dissolved in hot water and filtered, the precipitate and filtrate are both extracted with ether, the extracts washed with water and concentrated to an oily residue This is dissolved in alcohol and then suspended in water and extracted with ether, the ethereal extracts are washed with hydrochloric acid and water After removal of the ether the residue is suspended in water and heated with baryta the activity passes into the filtrate from which barium is removed as sulphate or carbonate The material appears to be in true (or colloidal) solution, since it is filterable and dialysable about 0 02 mgm solid matter will produce the œstrus response on injection There is no relationship between the nitrogen content and activity of the solution Millon's reaction is positive, but the biuret test is negative

There is an important difference between the reactions of the hormone in solution in oil and in water a single dose of an oily preparation will induce œstrus in an ovariectomised rat or mouse,

whereas a single dose of an aqueous solution may be entirely without effect a series of six injections spread over forty eight hours will, however, in the case of an active solution, produce œstrus on the third or fourth day The necessity of multiple injections of aqueous solutions was first stressed by Laqueur and has been fully confirmed by Dodds

The œstrus producing hormone occurs in the follicles and stroma of the ovary but is absent from true luteal tissue it is present also in placenta, urine, and probably blood It is probably produced by the cells of the ovarian stroma, whence it finds its way to the other situations in which it is found the follicle is certainly not an essential source, since ovaries sterilised by exposure to the X ray still produce it, animals thus sterilised passing through the cyclic changes of œstrus in a perfectly normal manner As regards its presence in the placenta, it is possible that this organ withdraws it from the circulation in order to protect the fœtuses from its influence

Œstrus supervenes after an injection of œstrin in about two days, and ovariectomy may be followed by œstrus 36 48 hours later, indicating that under natural conditions the stimulus to the vaginal re action is already active about two days before the reaction occurs Examination of the ovaries indi cates that follicular maturation occurs during the 48 hours before œstrus, that is, after the stimulus has become active so that both processes appear to depend on the same stimulus, and the view that the follicle is the source of the œstrous reaction becomes untenable (F W R Brambell and A S Parkes, *Quart Jour Exp Physiol*, vol 18, p 185, 1927) Injection of a large amount of œstrin has no effect on this latent period, but prolongs the period of œstrus even up to about a fortnight Ovariectomised animals are usually fat and sluggish œstrin restores activity and reduces weight, rats show a period of maximum activity at the time of œstrus The work that has been carried out on the effect of ovarian extracts upon metabolism indicates that in some animals (dogs), especially after castration, the nitrogenous meta bolism is increased whilst the gaseous exchange is diminished injection of extracts of corpora lutea has the opposite effect on the nitrogen output In other species, for example the rabbit, little change in the metabolism has been observed following the injections (V Korenchevsky, *Brit Jour Exp Path*, vol 6, p 6, 1925) L Mirvish and L P Bosman have found that alcohol extracts of ovary reduce the blood calcium of rabbits and human beings of either sex after injection, the effect reaching a maximum in twenty four hours with a return to normal in forty eight hours (*Quart Jour Exp Physiol*, vol 18, pp 11 and 29, 1927)

The influence of the menstrual cycle upon the mental and muscular efficiency and general func tional activity of women has been investigated by S C M Sowton, C S Myers, and E M Bedale (Industrial Fatigue Research Board, Report No 45, 1928) The direction of any change in efficiency at the menstrual period appears to be influenced by the social status of the subject studied, University students showing no change or a greater efficiency As regards functional efficiency, there appears to be a periodic heightening in the late intermenstrual phase with a corresponding reduction shortly before or at the onset of menstruation Since ovulation in the human female occurs about the middle of the cycle, this result is parallel to the greater activity observed in the rat at the time of œstrus

The changes in the uterus after œstrus do not appear to depend on the presence of œstrin in fact, prolongation of the action of œstrin hinders them and injected during pregnancy, abortion is produced Although probably responsible for the pro œstrous bleeding which is seen in some animals, the post œstrous bleeding which occurs in primates appears to set in when the action of œstrin wears off Thus hæmorrhage from the genital tract has a different significance in different species F H A Marshall considers that menstruation in the human female represents a pro œstrous and a pseudo pregnant degeneration of the uterine mucosa telescoped into one phenomenon in other words, each cycle commences before the previous one has completely finished a similar overlap is observed in the cycles of the cow (*Quart Jour Exp Physiol*, vol 17, p 205, 1927)

In several species, for example the guinea pig and opossum, a certain amount of mammary develop ment occurs during œstrus and can be produced in ovariectomised animals by an injection of œstrin or by grafting an ovary into a castrated male, but such development must be distinguished from that occurring during pregnancy In general it may be stated that post œstrous changes in the secondary sex organs depend on the influence of the corpus luteum developed by the ingrowth of cells into the ruptured Graafian follicle after ovulation, the actual degree of development of this body depending on whether the ovum has been fertilised or not, and also upon the species

In the rat and mouse the development of the corpora lutea of ovulation is very slight, in the guinea pig and cow more marked, whilst in the dog, ferret, and rabbit it is so considerable that the changes brought about in the accessory organs simulate those of pregnancy A sterile copulation in the rat or mouse is followed by a more prolonged development of the corpora which become func tional Histological differences between corpora of ovulation and pregnancy have been described by A Ostrčil and O Bittmann (*Publ Facult Médicine*, Brno, vol 4, p 217, 1926)

The functions of the corpus luteum, so far as they are at present known, are four in number the inhibition of œstrus and ovulation, sensitisation of the uterus for reception of the fertilised ovum, the maintenance of pregnancy and the development of the mammary glands preliminary to lactation Removal of the corpora of ovulation in animals in which they are functional results in an earlier appearance of the next œstrus, prolongation of the functional life of these bodies causes its prolonged disappearance A single body in one ovary can pro duce this effect, and injections of extracts are stated to inhibit ovulation in rabbits (W P Kennedy

Quart Jour Exp Physiol, vol 15, p 103, 1925) Conversely, Parkes and Bellerby have found it possible to produce œstrus during lactation in mice by injection of œstrin, the amount required depending on the number of young suckling above two (when spontaneous œstrus may occur) The inhibition to the action of œstrin is abolished in a lactating mouse unilaterally sterilised by exposure of one ovary to the X ray, by removal of the opposite ovary, containing the corpora lutea, indicating that the inhibition is certainly due to a secretion from these bodies

A functioning corpus luteum is associated with a sensitiveness of the uterine mucosa to stimuli, either the fertilised ovum or an artificial stimulus, resulting in the production of decidual tissue, in which the ovum, if present, can be embedded Artificial stimulation of the mucosa is without effect in animals such as the rat or mouse with a short œstrous cycle, in which the corpora of ovulation are probably functionless, but the uterus can be made sensitive by inducing pseudo pregnancy and is also sensitive during lactation, in both of these states the life of these organs is considerably prolonged Their influence is probably hormonic in nature, since a grafted uterus can be sensitised

The presence of a functioning corpus luteum is essential for the maintenance of pregnancy, or at any rate its greater part In unilaterally sterilised mice, removal of the ovary containing the corpora invariably resulted in abortion, whilst removal of the sterile ovary was without effect hence the presence of ovarian tissue *per se* is without influence on pregnancy, the corpus luteum being the essential organ (Parkes) In the cow the corpus can be expressed manually its removal results in abortion within a few days (O Zallmann, *Publ biol Haute École Vét*, Brno, vol 1, p 255, 1922) Towards the end of pregnancy the corpora lutea atrophy, evidence has been brought forward which suggests that during pregnancy the sensitivity of the uterus towards the oxytocic principle of the posterior lobe of the pituitary gland is diminished and returns to normal when the corpora atrophy also injection of extracts, obtained from ovaries at the end of pregnancy, stimulate the secretion of this hormone, suggesting a mechanism whereby the corpus luteum both maintains pregnancy and allows parturition at the proper time

The presence of functioning corpora lutea is associated with a degree of mammary gland development which is not observed in their absence, but it is not yet certain whether this stimulus alone suffices to bring these glands to complete lactation it is possible that some product of conception is necessary for the final development E Homann has suggested that the uterus plays a part in the development of the mammary glands (*Berich Natur forsch Gesellsch Freiburg*, vol 26, p 289, 1926)

(*To be continued*)

Infra red Spectra [1]

By SIR ROBERT ROBERTSON, K B E, F R S

HISTORICAL

IN the year 1800 the elder Herschel, by placing a thermometer in the region lying beyond the visible red of the solar spectrum, gave the first experimental proof of the existence of radiation there by observing a rise in temperature of the instrument, and his son in 1840 described the existence of emission bands in the same region as shown by a discontinuous evaporation of alcohol from blackened paper placed in the same region

To illustrate action beyond the visible red of the spectrum the following experiment was made As it was impracticable to use the sun's spectrum, the beam from an arc lamp was dispersed by means of a large rock-salt prism, giving the usual spectrum visible to the eye A card on which a phosphorescent powder (calcium sulphide with nickel as impurity) was first caused to glow brightly by subjection outside the theatre to ultra violet light from a mercury lamp and then placed in the spectrum, when the existence of radiation beyond the visible was shown by the quenching of the phosphorescence for some distance past the red

This region of the spectrum attracted much interest from the middle of last century and onwards when instruments of increasingly refined character were evolved to detect and measure effects of emission and absorption of radiation there Thus photography was tried, and Abney succeeded in penetrating the region for a short distance, which has not been exceeded by more recent workers employing special sensitisers for their plates Langley with the bolometer, Boys with the radiomicrometer, and Coblentz with the thermopile, succeeded in measuring quantitatively radiation in the infra red, the last two instruments are the principal ones employed to day in that region which lies nearest to the visible Still farther out, measurement of the energy in the beam dispersed by means of reflection from the polished surface of crystals gave important results in the hands of Rubens and his colleagues, while within the last year Raman by an entirely different technique, to be mentioned later, has indicated how infra red radiations can be deduced from spectroscopic measurements in the visible spectrum

ELECTROMAGNETIC WAVES

The relationship of the infra red region to other parts of the spectrum was illustrated by a diagram simplified from that prepared by Dr F E Smith (see "Phases of Modern Science," 1925), in which the whole range of electromagnetic waves from γ rays to the longest radio waves, and only completed in recent years, is set forth On this diagram (Fig 1) were indicated the respective lengths of the waves from crest to crest in each region the cosmic rays of Millikan, supposed by him to proceed from

[1] Synopsis of the Friday evening discourse delivered on Mar 1 at the Royal Institution

the birth of atoms such as helium, oxygen, silicon, and iron, in the profound depths of space at the lowest extremes of temperature and pressure, of a wave length of about $2 \times 10^{-8}\,\mu$ ($\mu = 0\,001$ mm), the highly penetrative γ rays about $4 \times 10^{-6}\,\mu$, which accompany radioactive change, the X rays about $1\,5 \times 10^{-5}\,\mu$, also penetrative of matter on account of their short wave lengths the ultra violet rays, to about $0\,4\,\mu$, which promote many chemical reactions, the visible spectrum, from about $0\,4\,\mu$ to $0\,8\,\mu$, infra red rays, from $0\,8\,\mu$ to about $23\,\mu$ (the near infra red) or to $300\,\mu$ (the far infra red), heat rays and short Hertzian rays to $1 \times 10^{8}\,\mu$, and then the rays used for wireless, the length of which may be measured in miles, 5XX, for example, being 1560 metres or about a mile long It is a characteristic of all these waves, from the shortest to the longest, that they are propagated at the same speed, the speed of visible light, or 186,000 miles a second

The clue to the properties of these waves was found by Faraday when he discovered rotation of the plane of polarisation of light in the magnetic field, a discovery of which Tyndall said "I would liken it to the Weisshorn among mountains, high, beautiful, and alone" This in turn was translated by Clerk Maxwell into the succinct notation of mathematics, and it formed the basis of his electro magnetic theory, the foundation of modern electro mechanics Since then, the likeness in character of these electromagnetic waves has been shown by their being capable of dispersion, interference, resonance, and by many other physical properties

As to the effects of the radiations in different parts of the spectrum, it may be said that whereas in the shorter wave length regions comprising the γ, X rays, and visible spectrum, these are mostly electronic, in the infra red region the transitions are caused by changes in the oscillatory states of the atoms in the molecule or of the rotational states of the molecule itself

QUANTITATIVE MEASUREMENT OF INFRA RED BANDS

Dispersion by means of a grating having been referred to, a modern infra red spectrometer of Hilger was then described as to its respective parts, the source of radiation (a Nernst filament), the slits, the reflecting mirrors, the dispersing prism (of quartz up to $3\,\mu$, fluorite up to $8\,\mu$, of rock salt up to $17\,\mu$, or of sylvin up to $23\,\mu$), and the thermopile Special reference was made to the thermopile, composed of bismuth silver couples used in conjunction with a galvanometer for measuring the energy passing through the instrument Its sensitiveness was illustrated by allowing a little compressed air to enter a sealed bell jar containing the instrument, when by adiabatic compression of the air, the heat generated was registered by movement of a spot of light from a Moll galvanometer

An experiment was then performed to illustrate the method of mapping an absorption band, ammonia being the gas employed Two tubes were so arranged that they could alternately be thrown into the optical path between the source of radiation and the spectrometer, one tube being empty while the other contained ammonia gas The energy passing through the respective tubes was measured by a galvanometer which threw a spot of light on a large scale on the wall of the theatre At $1\,8\,\mu$ the difference between the throw of empty and gas tubes was small, but this difference increased up to $2\,2\,\mu$ and then decreased These differences were noted and then plotted against wave length on co ordinates marked out on the blackboard, when a distinct band due to absorption by ammonia appeared in this region

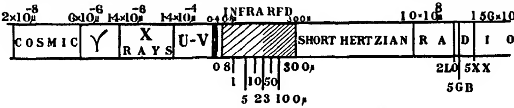

FIG 1 —Electromagnetic waves Velocity = 30 000 000 000 cm per sec = 186 000 miles per sec

OSCILLATION AND ROTATION BANDS

Bands due both to oscillation of the atoms in the molecule and rotation of the molecule itself are found in the infra red spectrum Oscillation bands were shown by Drude, from the phenomenon of dispersion in crystals, to be necessarily present, having wave lengths such as occur in this region of the spectrum, if certain smaller charged particles (electrons) are concerned in the ultra violet region As the effect is one of resonance, the atoms in a molecule respond in their vibration to radiation possessing some particular frequency, and this was illustrated by a model in which a ball suspended on a spring from the end of a light rod supported on two nodes, was made to perform vertical oscillations, whereupon a ball similarly suspended at the other end of the rod picked them up and vibrated vertically in phase with the former ball The electronic linking between the atoms prevents their oscillation being truly sinusoidal, harmonics may therefore be expected and are in fact found

Molecules also undergo rotation, and this effect is reflected in their infra red spectra The main bands are due to oscillation, but in addition the rotation of the molecule also produces bands, of a simple character in the far infra red, but in the near infra red as fringes superimposed on the oscillation bands Rayleigh, assuming on the basis

of classical mechanics a Maxwellian distribution of velocities, in 1892 showed that an oscillator emitting and absorbing at a frequency ν_0 due to its oscillations alone, would, when rotating about an axis perpendicular to its line of vibration with a frequency ν_r, emit and absorb at the new frequencies $\nu_0 + \nu_r$ and $\nu_0 - \nu_r$. This seemed at first to meet the case, as in some of the early bands, such as those of Burmeister, two broad areas occurred which the Maxwellian distribution of rotational velocities would require. In 1911, however, Nernst concluded that rotation must also be quantised, and in 1912 Bjerrum and E. v. Bahr resolved a band of hydrogen chloride into a series of small bands, which they ascribed to the effects of rotation of the molecule. This band has been better resolved by Imes and others, and from the spacing of the fringes the diameter of the molecule of hydrogen chloride has been calculated. Sommerfeld, applying the principle of Bohr, showed that the equal spacing of the fringes is best explained by quantising the moment of momentum, so that each quantum jump represents a change in the moment of momentum. If the moment of momentum $J\omega$ is taken as a whole multiple of $h/2\pi$, $J = mh/2\pi$ and $E_{\text{kin}} = \frac{h^2}{8\pi^2 J}m^2$, by the Bohr Einstein conception

$$h\nu = E - E_1 = \frac{h^2}{8\pi^2 J}[m^2 - (m+1)^2] = \frac{h^2}{8\pi^2 J}(2m - 1),$$

whence the space difference is $h/4\pi^2 J$, a result in accordance with facts. It will be seen that by putting the spacing difference $\Delta\nu = \frac{h}{4\pi^2 J}$, the moment of inertia of the molecule can be calculated, and, from the moment of inertia, given the masses of the vibrating atoms, the length of the molecule.

INFORMATION GIVEN BY INFRA RED SPECTRA

In the first place, we get the frequency of oscillation of the atoms within the molecule, and the frequency of rotation of the molecule itself. These have been shown for a simple molecule such as that of hydrogen chloride. In addition, with more complicated molecules, it is possible to construct models by taking into consideration the presence of absorption bands and assuming a law of force between the atoms in the molecule. Thus Hund considers that ammonia has a tetrahedral structure, and this is probably also the case with the analogous phosphine and arsine. With these gases at least three sequences of bands have been found in each, corresponding with three degrees of freedom of oscillation, one of the sequences in each gas having five or six harmonics. In this sequence the frequency of vibration gets slower as the weight of the atoms nitrogen ⟶ phosphorus ⟶ arsenic increases in the three gases.

It is interesting from the chemical point of view to see if any of these degrees of freedom correspond to the chemical bonds of the chemists, and some hint of this is obtained in one case at least. Thus by progressively substituting the H in NH_3 by CH_3, a certain band—the first harmonic of the main sequence mentioned above—disappears from the spectrum after the last H has been substituted, so this degree of freedom of oscillation has been identified as connected with the chemical bond N H.

Again, as regards rotation, we have found two moments of inertia in ammonia, of which one can be attributed to rotation round the median line and the other round the centre of mass at right angles to the median line. Calculation of the length of the molecule, as above described, gives a value similar to, although somewhat smaller than that obtained by Rankine from measurements of viscosity of this gas. By the comparison of spectra of related compounds, as for example in the case of hydrocarbons, definite bands have been attributed to certain groups or radicles. In the case of solids, certain groupings such as NH_4^+ or CO_3^- have similarly been identified in the spectrum of salts.

In the hands of Coblentz, infra red data and technique have been used to determine the quantity of radiation from the sun, stars, and planets, and he has also deduced the temperatures which prevail in these bodies, and even the differences in radiation from the hemispheres of Mars.

The knowledge of the infra red spectrum of water vapour and of carbon dioxide is of importance in considering the nature and quality of energy reaching us from the sun, and only recently Dr. G. C. Simpson, by making use of the absorption coefficients of water and carbon dioxide in the infra red, has deduced that an increase in solar radiation would result in increased cloud and precipitation, and even in the apparent paradox of an ice age. Further, Paschen's determination of the emission and absorption bands of these gases is fundamental in questions relating to combustion.

FUTURE WORK IN THE INFRA RED

Such are some of the results that spring from the consideration of infra red spectra. On the more theoretical side it has thrown light on and given support to the quantum theory. It has passed into the hands of the still more modern exponents of the wave mechanics and found to be in accord with their predictions, as for example in connexion with the assumption of half quantum numbers. This is a field in which its usefulness is only beginning.

Only last year, Prof. Raman of Calcutta, by imposing monochromatic radiation from a mercury lamp on gases and liquids, observed spectroscopically in the scattered light not only the original line but also others at frequency differences which he finds are equal to frequencies in the infra red at which bands characteristic of the gas or liquid were known. This brilliant experimental confirmation of the quantum theory may prove of the highest importance from a theoretical point of view when it comes to be explained why in the Raman effect not all the bands found in the infra red by the usual means appear, and why others appear to be disclosed only by the Raman effect.

Like the X rays, the infra red deals with the

structure of the molecule but while X rays reveal the molecule in its static condition and are especially applicable to solids infra red spectra reveal the dynamic characteristics of the molecule in gases liquids and to a restricted degree in solids In the future it will undoubtedly be used to a greater extent in the determination of the nature of chemical linkages and generally for a solution of problems of chemical constitution

As Garner and his school have shown important deductions can be made as to the rôle of infra red radiation in combustion as for example in the effect of water when it is present in carrying off the energy of radiation produced when carbon monoxide combines with oxygen and as the bulk of the radiation from flames is in the invisible part of the spectrum and mainly in the infra red there is here a wide field of work in clearing up the mystery of flame and the same is true as regards the phenomena of explosion of both gaseous and solid explosives

It is to be regretted however that more work is not being done in Great Britain in the exploration of this region It is true that the technique is difficult and there have been several investigations reported of an accuracy that leaves a good deal to be desired Most of the work until now has been done in Germany and in the United States little having so far come from British universities with the exception of Cambridge where there is an embryonic school The subject is perhaps scarcely one suitable for a young graduate to acquire the technique and embody a year s work in a thesis for some degree but one for a more permanent staff and I should like to make a plea for its greater consideration in Great Britain as a field of experiment and study likely to assist in the solution of many physical and chemical problems which in due course will have its reflection in the domain of technical application

Sir J J Thomson has given us the electron Rutherford the proton with its planetary electrons and the structure of the proton the Braggs have elucidated the structure of many molecular fabrics but the molecule as a dynamical entity has been comparatively neglected For it is in the infra red region of the spectrum that this behaviour can best be studied In this aspect the problem is a physical one for the most part the technique is difficult but likely to be productive of much that is important in our conception of the structure of matter It is for this reason that one would like to see in Britain a strong school arise which would have as its object the study of the dynamical behaviour of the atoms in the molecule and of the molecule itself

Obituary

PROF WILLIAM KUSTER

DR WILLIAM KÜSTER professor of organic chemistry and technology at the Technische Hochschule in Stuttgart died suddenly on Mar 5 of heart failure From the pages of a recent issue of the *Chemiker Zeitung* we glean the following details of his career

Born at Leipzig in 1863 Kuster received his early education in Berlin and studied later at the Universities of Tubingen Berlin and Leipzig At Leipzig he worked under the direction of Wislicenus with whom he remained for a while after graduation until he was appointed assistant to Hufner at Tübingen where he was given charge of the practical chemistry classes for medical students In 1894 he published his first paper on salts of hæmatin This was followed by an intensive study of the pigments of blood and bile subjects which he made peculiarly his own and remained his chief interest throughout life

In 1903 Kuster was appointed professor of chemistry and pharmacology at the veterinary college at Stuttgart and lecturer on pharmaceutical chemistry at the Technische Hochschule The duties attached to these offices were so burdensome that but little time was available for research Moreover at the veterinary college he found that no provision had been made by his predecessor for experimental work In spite of these difficulties he succeeded during the next eleven years in publishing numerous papers on hæmatin porphyrin pyrrole, and bile pigments

On the retirement of Prof C von Hell, the department of chemistry at the Technische Hochschule at Stuttgart was completely reorganised and Kuster was appointed to the chair of organic chemistry and technology Under his direction the department was greatly enlarged and in spite of the difficult nature of the work in which he was engaged he attracted a great number of research students to assist him in his investigations In this way Küster and his collaborators were able to make a large number of important contributions in the field of biochemistry Later his interest extended to other branches of natural products such as sugar albumen lignin etc He also contributed to the well known handbooks of Abderhalden and Thoms

WE regret to announce the following deaths

Prof Jules Cornet the distinguished geologist and professor in the University of Ghent and at the School of Mines at Mons *correspondant* of the Paris Academy of Sciences who was well known for his geological explorations in the Congo in 1892 and 1895, on May 17

Mr Stewart Culin curator of ethnology in the Museum of the Brooklyn Institute, Brooklyn, N Y, known especially for his comparative studies of the games of North American Indians and other races, on April 8 aged seventy years

Prof Charles Depéret professor of geology in the University of Lyons and a foreign correspondent of the Geological Society of London on May 17, aged seventy four years

M Ulysse Gayon a distinguished biologist and chemist and honorary doyen of the Faculty of Sciences at Bordeaux, aged eighty three years

News and Views.

In the short address which he delivered at the dedication of Darwin's home to the nation on June 7 (Nature, June 8, p 875), Sir Arthur Keith touched upon the relationship between sentiment and science When sentiment enters a laboratory by the back door science takes the earliest opportunity to escape by the front, yet, since life is as it is, science cannot easily be cut adrift from personality The value of such a gift as that which Mr Buckston Browne has made to the British Association lies in the power of the personal associations of its material contents and surroundings to throw the visitor back into the very atmosphere of the century and of the place in which Darwin moved and thought So a background of sentiment is formed which illumines and may help to interpret the development of the man's mind and the direction of his labours Down House is a memorial, not to Darwin's science, which will outlast our buildings, but to his personality It is especially appropriate therefore, that the donor should have expressed the wishes that the house and grounds should be maintained in a state as near as possible to that in which Darwin modelled them, and that they should be used to advance the cause of science, in ways in which the Council of the British Association thinks best "If any place can provide inspiration for research it should be Darwin's own gardens"

Sir Arthur Keith's presidential address at the annual congress of the South Eastern Union of Scientific Societies on June 5 at Brighton was singularly happy both in subject and method of treatment In demonstrating the racial characters of the pre Roman inhabitants of Southern England, he was able to draw much of his material from discoveries on the South Downs relating to prehistoric man, and to refer to material evidence deposited in local museums Taking the skeletal remains found in the neighbourhood of Brighton, the Maycroft skeleton, the Ditchling and Blackpatch (Worthing) finds, he linked them up with the crouched burial discovered at St Catherine's, in the Isle of Wight, some three years ago Hence by means of the identification by Mr O G S Crawford of a peculiar piece of pottery found in 1881 in a burial at Nunning, some ten miles from St Catherine's and preserved in the Carisbrooke Castle Museum, he was able to relate the Brighton folk as kin to the Beaker folk who settled in Britain at the end of the neolithic and beginning of the Bronze Age some two thousand years before Christ, a relation to which the skeletal remains had pointed, but for which cultural evidence indicative of a chronology had been lacking It was outside Sir Arthur Keith's purpose to trace the Beaker folk back to their origin on the continent, but he did refer to the related flint miners of Belgium, this enabling him to offer an interesting suggestion of child sacrifice as a possible explanation of the discovery of skeletons of children buried with those of adults

It is unnecessary now to follow Sir Arthur further, when, pointing out the gap in our knowledge of the physical characters of the inhabitants of Britain after the settlement of the Beaker folk, he turned to trace the history of the people of Southern England back through the finds which could be dated to periods immediately preceding the Roman invasion It may be noted, however, that here again he gave full weight to local investigation and also to those of Mr and Mrs Cunnington at All Cannings Cross and Woodhenge In fact, throughout the whole address it was patent that he addressed a wider public than his immediate audience, and had in mind the broader aspects of the specific problems with which he was concerned His brilliantly lucid reconstruction of the racial history of prehistoric Southern England was in fact a convincing demonstration of the methods of study of prehistory and an eloquent plea for a wider recognition of the value of archæology in the reconstruction of history Sir Arthur Keith brought out even if he did not specifically stress in every instance, the value to archæological studies of what may be termed localised research It has been mentioned that his material was largely drawn from local investigations Not only was this the case, but also it was by means of the correlation of local records and the examination of local evidence when housed in museums within reach of its original environment that this pregnant comparative study was made possible Hence Sir Arthur Keith's address should provide a stimulus to all local archæologists and all local scientific societies

After the great paroxysmal eruption of Vesuvius in 1906 there followed seven years of obstruction and comparative repose In 1913 the conduit became open and the normal type of external activity began Since then the crater has been steadily filling from a succession of central conelets, and at intervals in recent years there have been minor crescendos of explosive and effusive activity By far the greatest and most spectacular of these broke out in the early hours of June 3 The outburst began with tremendous explosions and the hurling into the air of masses of incandescent material The central conelet split and collapsed As it fell back into the crater lava welled out and occupied the north eastern quadrant of the crater Prof Malladra announced on June 3 that he considered the eruption to be one of the periodic recrudescences of activity, that it was unlikely to last more than two or three days, and that a disastrous eruption of the culminating type—such as those of 1872 and 1906—was not yet to be expected

On the morning of June 4 it became clear that for a minor eruption the manifestations were more than usually violent The interior of the crater now became a lake of effervescing lava some 500 yards in diameter The lava overflowed into the Valle dell Inferno and escaped down the outer slopes into the valley of Cuppaccio and towards the little town of Terzigno, following the course of the 1834 lava-stream After a short interval of quiescence from 2 30 to 7 30 P M there was a sudden paroxysm of activity for three quarters of an hour Incandescent matter rose

1500 feet above the crater and fell in glowing showers on the slopes of the volcano Afterwards there were loud and frequent explosions, followed by an ash cloud that rose to still greater heights From 11 P M on June 5 to 3 A M on June 6 there were further tremors and explosions, and columns of lava were thrown into the air to break into incandescent bombs Since then there have been (at the moment of writing) no further reports of activity The lava stream has extended five miles down the south eastern slopes, widening to a frontage of 900 yards, destroying 110 acres of cultivated land and wiping out three small hamlets Although Terzigno was evacuated with the prompt aid of the military, the township itself has fortunately been spared, the lava having halted 300 400 yards from the houses It is estimated by Prof Malladra that the volume of lava approaches half that emitted during the 1906 eruption

THERE is a remarkable article in the June number of the *Realist* which will arouse interest and, it may be hoped discussion in wider circles than even the readers of this journal It is a merciless, and on the whole well founded analysis—most people would call it an exposure—of Wordsworth's appreciation of Nature Prof Herbert Dingle in "The Analytical Approach to Wordsworth", shows by abundant quotations what was the actual mental attitude of the poet towards the Nature which he worshipped It was not one of questioning or of interest in the changes or process of Nature but of passive meditation and happy acquiescence in scenes and thoughts which were familiar to him He does not seek for truth but for a mystic sublimity of feeling of which the attainment was a solemn duty of man He never therefore particularises either in describing a person or a natural object Cliffs are simply 'lofty' and trees 'dark', just as his human beings are distinguished not by their interesting peculiarities but by their age or their occupation, things common to a host of people

PROF DINGLE scarcely does justice to the stimulus towards science given by the preface to the second edition of the "Lyrical Ballads" in 1800, which is one of the most admirable things in English criticism and puts the man of science and the poet in a friendly and natural relation together Yet even in speaking of this, Prof Dingle manages to put his finger on a weakness, or at least a limitation, of Wordsworth's attitude The poet when speaking of the labours of the man of science regards him as isolated from the poet it is only when finished products are reached that the poet can take them up and make use of them Just as in science Wordsworth would make use of the finished product, so in human society he tends more and more to dwell on the past His attitude is thus almost completely static, as Shelley's by his burning forward vision and exuberant imagination becomes vague and unreal The whole question is of extraordinary interest and it is much to be hoped that critics interested both in science and poetry will take it up Sully Prudhomme raised the same point in France about a hundred years later and lamented how little influence the strides of science had exercised on the inspiration of poets in the interval Perhaps the growth in mass and specialism of science makes contact all the more difficult what Prof Dingle makes us desire is a greater community of spirit

IN *Engineering* for May 31 is an illustrated account of the famous Carl Zeiss Optical Works at Jena, which owe their foundation to the partnership of Carl Zeiss (1816–1888), an instrument maker, and Ernst Abbe (1840–1905) the physicist, begun in 1866 At one time the works employed nearly 10,000 men and women, and in the article is a plan showing the development of the Zeiss Factory at various periods and the recent extensions The original workshops were in the town of Jena, and in 1876, by which time the 3000th microscope had been sold, the present site was purchased In the early 'eighties Otto Schott, the glass maker, became associated with Zeiss and Abbe, but the glass works, though administered by the Carl Zeiss Foundation, remains independent of the instrument factory Brief accounts are given of Abbe's contributions to mathematical optics, of the manufacture of optical glass, and of the formation and working of the Carl Zeiss Foundation, and together with these are a few details regarding the planetaria constructed by the firm, and of the Zeiss double refracting telescope sent to the Lembang Observatory, Java, and of the 650 mm refractor finished in 1914 for the Neu Babelsburg Observatory, Potsdam

IN the same issue of *Engineering*, in a Supplement dealing with the exhibits at the North East Coast Exhibition, Newcastle upon Tyne, opened by H R H the Prince of Wales on May 14, is a short description of the 36 inch reflecting telescope made by Messrs Sir Howard Grubb, Parsons & Co, for Edinburgh Observatory Built to the specifications of Prof Sampson, Astronomer Royal for Scotland, the telescope is mounted equatorially, three rates of motion being provided for both axes, the fastest giving one revolution in 3 minutes, while for fine setting the rate of movement is one revolution in two days and for guiding one revolution in 60 days The optical system is that introduced by Cassegrain in 1672, the main mirror of parabolic form being 37 in in diameter, 6 in thick, and having a central aperture $3\frac{1}{2}$ in in diameter Its focal length is 15 ft The Cassegrain mirror, near the upper end of the tube, is of hyperbolic section, 10 in in diameter, and is designed to give an equivalent focal length of 54 ft in conjunction with the main mirror The instrument will be installed in Edinburgh Observatory at the close of the Exhibition

THE eighty second annual meeting of the Palæontographical Society was held in the rooms of the Geological Society, Burlington House, on May 31, Dr F A Bather, president, in the chair The annual report announced the publication at an early date of new monographs on Corallian Lamellibranchia, by Mr W J Arkell, and on Cretaceous Terebratulidæ, by Dr M R Sahni It also made special reference to the death of one of its oldest members and most

valued contributors, Sir William Boyd Dawkins Mr A J Bull, Dr O M B Bulman, Dr L F Spath, and Mr S Hazzledine Warren were elected new members of Council Dr F A Bather, Mr Robert S Herries, and Sir A Smith Woodward, were re elected president, treasurer, and secretary respectively In a brief address, the president alluded to the numerous gaps in the series of monographs on British fossils which still existed, and made suggestions for future work

THE Medical Research Council, after consultation with the Ministry of Health and the Board of Education, has appointed the following committee to inquire into the prevalence and mode of spread of minor epidemics in residential schools especially those believed to be spread by 'droplet infection', and to report upon the means by which they may be prevented or restricted Sir George Newman (Chairman), Dame Janet Campbell, Dr R H Crowley, Surgeon Comdr S F Dudley Dr J A Glover Prof M Greenwood, Mr L R Lempriere Miss E M Newbold, Prof W W C Topley, and Mrs Joyce Wilson (Secretary)

DURING the past season the price of oysters has remained at a high level, owing mainly to the scarcity of stocks In an article on British Oyster Fisheries published in NATURE of March 23, Dr J H Orton discussed the various causes for this scarcity and indicated, in particular, the dangers of over fishing In this connexion it is worth while to direct attention to a "Report on a Survey of the Fal Estuary Oyster Beds" (November 1924) "With Notes on the Biology of the Oyster" (published by private subscription at Falmouth, 1926, but obtainable from the Marine Biological Association, Plymouth, price 2s 6d), in which Dr Orton deals with a particular depleted fishery and suggests various measures to restore it to a productive state The report is of great value to all concerned in the investigation and administration of oyster fisheries, but being privately printed it may easily escape the notice of those interested

THE bird sanctuary at Duddingston Loch, in the Royal Park of Holyrood in Edinburgh, is making satisfactory progress, and the third Report of the Committee (Edinburgh and London H M Stationery Office 6*d* net) shows that its members are keeping close watch on the development of the area Further planting of trees has taken place, with the object of forming a screen to keep out engine sparks from the neighbouring railway, to which was due a disastrous fire in the spring of the previous year One of the problems of the Loch has been the remarkably few aquatic species of birds which reared young to maturity in spite of the large number of nests, and this is attributed partly to the presence of many pike in the Loch itself, and partly to the frequent attentions of some lesser black backed gulls An attempt was made to reduce the former by dragging the loch, the latter emphasise the danger run by any policy of wholesale and indiscriminate protection The entomological and botanical surveys of the area inaugurated in 1927 with the view of studying the interrelations between plant and animal life have been continued, and a short note on the entomology of the sanctuary, by P H Grimshaw, of the Royal Scottish Museum, concludes the report

THE story of the Greenland whaling industry, in which Great Britain shared in the seventeenth and eighteenth centuries, has been traced in connexion with many of the seaports taking a major part in the 'fishery' For the first time, however, an attempt has been made to give a consecutive account of the whaling of the port of Aberdeen, in an excellent article by James Pyper, in a recent issue of the *Scottish Naturalist* (p 39) In 1749, for the first time, whaling vessels sailed from Scotland, and in 1752 Aberdeen entered the trade with two vessels By 1814–17 the port stood only after Hull and London in the number of its whaling ships and its tonnage of oil Five years later London had dropped out of the first rank, and Peterhead, with 16 vessels, stood second to Hull with 40, Aberdeen, with 14 following third In the average tonnage of oil per vessel, however, Aberdeen now stood first, the total cargoes amounting to 1225 tons It was a small return compared with the enormous catches of the present day finner industry, but it spelt a season of prosperity for the northern seaport The account gives a vivid notion of the ups and downs of the fishery Of the ten ships which sailed in 1830, four were lost in the ice with six of their crews, two ships returned from the fishing 'clean', one had two whales, and the remaining three, a single whale each

THE Report for the year 1928 of the National Physical Laboratory covers 284 pages, of which 200 are devoted to detailed accounts of the work carried out in the various departments These accounts are well illustrated and show that the Laboratory continues to maintain its position as one of the most active centres of research into questions bearing on our national industries The projected new physics building, which has been referred to in the annual reports for many years, is now under construction so far as its central block is concerned, and the scattered rooms in the basement and other parts of Bushy House previously occupied by the Physics Department are to provide accommodation for the Electrical Standards and other departments Work on standards of measurement has been carried on actively during the year, and with the increase of test work for the industries has diminished the time devoted to general research The high voltage equipment is nearing completion and will enable tests up to a million volts to be made A useful addition to the report is a section of 20 pages giving precise definitions of the units and standards of measurement employed at the Laboratory

IN his discourse on "Excavations at Ur, 1928–1929", at the Royal Institution on June 7, Mr C Leonard Woolley gave a short account of the final clearing of the great temple of the Moon god Nannar, whose history was traced from the foundation of the building by king Ur Nammu about 2300 B C until its last restoration by Nebuchadnezzar in the sixth century B C The main part of the lecture was devoted to a

record of the continued excavation of the prehistoric cemetery More royal tombs were found, two of which gave entirely new information as to the ritual of a king's funeral, one of these was intact, and the tomb chamber, the stone dome over which was found unbroken, contained some remarkable gold objects Much richer than this was a 'death pit' containing seventy four bodies, many of them lavishly decorated with gold, and four harps and two statues, these are among the finest objects of art yet discovered in the cemetery Other graves produced a very large collection of funeral furniture in gold, silver, copper, stone, and clay, of which the more important were illustrated Finally, a description was given of the work carried on at a lower level than the graves, which resulted in finding evidence of the historical character of the Flood

IN Basel on Oct 8–12, 1928, was held an interesting short course upon the use of electrostatic methods in biochemistry and biology, in which a group of scientific workers gathered from various centres were introduced particularly to the work of the Prague school (Prof R Keller R Furth, etc) Some of the communications given at this 'school' are published in the *Kolloidchemische Beihefte*, vol 28, 1929 (pp 208 390) After general introductory papers by Prof Spiro, of Basel, and Prof Keller, papers were given upon methods of measuring electric potentials in the organism, upon the preparation of micro electrodes, pH determination in living organisms, upon the use of vital staining in biology, upon dispersoid analysis by a new dialysing apparatus, etc In all many new experimental avenues of approach to biological problems were discussed and some results obtained by these new methods briefly indicated Many new fields of biological investigation are being actively pursued by this group of investigators, who are introducing physical methods into biochemistry and biology, and this collection of papers illustrating their outlook will be of interest to workers in widely different fields

THE great demand for cheap electrical power for heating makes it necessary to raise the transmission voltage to the highest permissible limit, as otherwise the cost of the large amount of copper in the mains is prohibitive from the commercial point of view Even to relatively short distances, a voltage of 132,000 is being used In Berlin quite recently an overhead line several miles in length for transmission at 100,000 volts has been erected in the suburbs of the city The question of carrying this line to the centre of the city is at present under consideration, and in all probability underground mains will be used In Hamburg there are at present two cables, each nine miles long, working at 60,000 volts, and in Nurnberg there is an underground cable connecting two net works, which works at 110,000 volts In the event of a fault to earth occurring on a high tension cable, a very large current will flow, and the cable will be seriously damaged for several yards on each side of the fault An interruption of the supply will probably ensue A method of preventing this is described in *A E G Progress* for April The high voltage underground networks are connected with Petersen arc suppressors In the event of a fault occurring these devices allow a lagging current to flow through the fault This combines with the 'capacity to earth' current at the point, making the voltage of the cable at the point practically zero and preventing a serious fault from developing It prevents also the development of high frequency currents which arise when an arc ensues These currents, as Duddell pointed out many years ago, may cause resonance voltages at points remote from the fault and so break down the insulation of the cable In Great Britain and in America, steady progress is being made in the development of very high voltage cables, but we think more attention should be paid to developing devices to safeguard them when in operation

THE Medical Research Council announces that, on behalf of the Rockefeller Foundation, it has made the following awards of travelling fellowships for the academic year 1929–30 These fellowships are awarded to graduates who have had some training in research work either in the primary sciences of medicine or in clinical medicine and surgery, and who are likely to profit by a period of work at a chosen centre in America or, in special cases, in Europe, before taking up positions for higher teaching or research in the British Isles Olive B Buckley, Dr G A C Gough, W R Henderson, Dr D Hunter, G E Lewis, Dr M M Suzman, Janet M Vaughan Dr Gough's fellowship is tenable at the University of Munich, the others at centres in the United States

THE condition of St Mary's Abbey has caused concern to the Council of the Yorkshire Philosophical Society, and following upon a thorough inspection and report by H M Office of Works, it has been recommended that certain steps should be taken to improve the amenity of the site and to ensure the preservation of such portions as remain The estimated cost of the work proposed is £3370

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —A lecturer in economic history and economics at Armstrong College, Newcastle upon Tyne—The Registrar, Armstrong College, Newcastle upon Tyne (June 19) Two forest officers under the Forestry Commission—The Secretary, Forestry Commission, 22 Grosvenor Gardens, S W 1 (June 20) Two temporary investigators and a temporary assistant under the Department of Agriculture for Scotland, in connexion with an inquiry into the marketing of livestock and other agricultural produce in Scotland—The Establishment Officer, Department of Agriculture for Scotland, Queen Street, Edinburgh (June 21) A teacher of agricultural science under the Londonderry and Limavady Regional Education Committee—The Principal and Secretary, Education Office, Limavady, Co Londonderry (June 22) A Paterson research scholar in the Cardiographic Department of London Hospital—The House Governor, London Hospital, E 1 (June 22) An advisory officer in agricultural botany at the Edinburgh and East of Scotland College of Agriculture

—The Secretary, Edinburgh and East of Scotland College of Agriculture, 13 George Square, Edinburgh (June 28) A lecturer in geography at Armstrong College, Newcastle upon Tyne—The Registrar, Armstrong College, Newcastle upon Tyne (June 28) An assistant part time lecturer in the biology department of the Plymouth and Devonport Technical College—The Education Office, Rowe Street, Plymouth (June 29) A full time teacher, for building trade subjects, at the Cheltenham Technical School—The Principal, Technical School, Lansdown Road, Cheltenham (June 30) Four assistant conservators in the Indian Forest Service—The Secretary, Services and General Department, India Office, S W 1 (July 1) An assistant in geography at the London School of Economics and Political Science—The Secretary, London School of Economics, Houghton Street, W C 2 (July 1) A mining engineer under the Safety in Mines Research Board—The Under Secretary for Mines, Establishment Branch, Mines Department, Dean Stanley Street, Millbank, S W 1 (July 2) An assistant or junior lecturer in the department of zoology of the University of Edinburgh, with special knowledge of invertebrates—The Secretary the University Edinburgh (July 5) A professor of physiology at the Medical College, Vizagapatam, Madras — The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, S W 1 (July 6) A senior lecturer in biochemistry in the University of Stellenbosch, South Africa—The Registrar, University of Stellenbosch, Stellenbosch, South Africa (July 31) A lecturer in mathematics at the Gordon College, Khartoum—The Controller, Sudan Government, London Office, Wellington House, Buckingham Gate, S W 1 A resident tutor (woman) to take geography and some education at the Edgehill Training College, Liverpool—The Principal, Edgehill Training College, Liverpool A lecturer in electrical equipment of the motor car at the Wimbledon Technical Institute—The Principal, Technical Institute, Gladstone Road, S W 19 A teacher of building subjects at the Croydon Polytechnic—The Principal, Croydon Polytechnic, Scarbrook Road, Croydon A lecturer in building at the Huddersfield Technical College—The Director of Education, Education Offices, Huddersfield A male junior assistant at the Chemical Warfare Research Department of the War Office—The Chief Superintendent, Chemical Warfare Research Department, 14 Grosvenor Gardens, S W 1 An assistant lecturer in physics at the University College of Hull—The Secretary, University College, Hull An assistant in the mechanical engineering Laboratory of University College, London—The Secretary, University College, Gower Street, W C 1 Two male laboratory assistants in the Research Department, Woolwich, with laboratory experience in physics—The Chief Superintendent, Research Department, Woolwich S E 18 A head of the experimental branch under the directorate of ballistics of the Research Department, Woolwich—The Chief Superintendent Research Department, Woolwich, S E 18

Our Astronomical Column

FIREBALL OF MAY 30 —A brilliant fireball was observed from several stations in Cornwall on May 30 at about 11 0 P M G M T Observations have however, come in from only Lostwithiol and Bugle, and these are of somewhat rough character The meteor gave a very brilliant flash and lit up the surroundings to such a degree that the observers found it difficult to note exact features of the path It passed along the southern sky from west to north and was evidently from a radiant in the eastern region of the heavens Its motion was moderately slow, for it occupied 4 or 5 seconds in its flight One of the observers, who was walking in the direction away from the object, says that he observed a great light behind him as though a brilliantly illuminated motor car was overtaking him It appeared like a dazzling ball of fire, but when a good view was obtained of it the nucleus appeared relatively small, though surrounded by a strong glare which apparently lit up the country Further observations are required of this interesting object, which came on the night of the general election, and on this account may have attracted notice from a greater number of observers than it would otherwise have done

VENUS A MORNING STAR —Venus is now a 'morning star' and will continue to precede the sun during the remainder of the present year The planet will attain its greatest elongation on June 29, when its position will be 46° west of the sun Its brilliancy is now declining, but not to any great extent Atmospheric conditions introduce more variations than are sometimes brought about by real differences Thus Venus will appear brighter when its computed lustre is less and when the air is very clear, than at a time when atmospheric vapours dim its light

Venus is now approaching Jupiter and the two planets will arrive at conjunction on July 14 at 10 A M, when Venus will be placed about 3° S of Jupiter Before sunrise this pair of attractive objects may be viewed in the E N E sky before sunrise Venus rising ten minutes after midnight, and Jupiter fifty seven minutes after midnight If the morning sky is clear the two planets may be easily identified and their relative brightness compared

SATURN —The planet Saturn will reach opposition to the sun on the night following June 21 The apparent magnitude will be + 0 2, and the planet will appear brighter than at an ordinary opposition because of the more favourable conditions prevailing The rings will be widely open and the planet will be situated almost midway between aphelion and perihelion At an unfavourable opposition, Saturn may shine as a star of + 0 8 mag only, but with attendant conditions favourable it may appear as a + 0 2 mag star It is true the aspect is by no means starlike, for the planet shines with a steady, dullish light, much in contrast with the sparkling diamond like brilliancy of the fixed stars At the time of Saturn s best display this year, its position will be placed on the extreme west border of Sagittarius, and as the planet is moving westwards it will shortly after enter the south region of the constellation Ophiuchus, and be visible to the north east of the star 44 Ophiuchi For critical observation the planet cannot be considered in a good position, its declination being 22° south, and its altitude, when passing the meridian, not greater than 16° or 17° to observers in the south of England

Research Items

INHERITANCE FEES.—In *Man* for May, Mr. J. P. Driberg directs attention to an element in primitive marriage which appears to have escaped general observation, namely, the inheritance fees or dues paid by an inheritor of a widow to the responsible members of her family. Such a fee has been found to be compulsory among three unrelated peoples—the Lango of Uganda, and the Didinga and Bari of the Sudan. Among the Lango a widow is normally inherited by a brother of the deceased or by his sister's son: in either case a bull being payable to the woman's family. She is differentiated from the wives by being called an inherited wife. Among the Didinga the deceased's brother pays the fee and calls the children his own; but if a sister's son or mother's sister's son inherits the widow, the son pays the fee and claims any children of the new marriage. Among the Bari, when a sister's son inherits, the fee is paid from the estate and the children belong to the estate. This seems an anomalous custom, as the bride's family had already received the full price from the original husband. It arises from an intention of making clear the economic and social status of the children of the new marriage. Marriage is not regarded as completed until the birth of the first child. The bride may not be called a wife till then. Sometimes she only lives in the bachelor's hut until the child is born. In the case of a divorce the bride price is returned and the children go with the mother; but the father even after years may recover the children on payment of the 'heifer of upkeep' to the family of the girl or her new husband. Among the Bari, if a marriage takes place without payment of the bride price, the wife's family take all the bride price paid at the marriage of the first daughter of the union. If there is no daughter the family keeps a son until he is ransomed.

THE SHISHAK MIGRATIONS.—Sir Flinders Petrie in *Ancient Egypt*, Pt. 4, 1928, states that the excavations at Gerar (Palestine) have produced repeated evidence of a movement from Central Asia to the west at about 950 B.C. Pottery models of square waggons with divisions from front to back and with two types of pottery wheels, one smooth, the other knobbed, are found. Similar waggons come from Anau, and knobbed wheels occur in the treasure of the Oxus, from 300 miles farther east. The latter wheel is designed to prevent sinking in sand and belongs to desert dwellers. Two types of bronze arrowhead come from Central Asia, one with a tang similar to a type found at Tomsk; the other is the triangular bladed arrowhead of Minussinsk, Altai, Perm, Siberia, and south-west Caspian. The broad bladed iron dagger belongs to Anau, the Caspian, and Caucasus. Lastly, all the pottery figures of oxen are humped, a central Caspian type not found west of Mesopotamia. This movement, dated at 970 B.C., links with Sheshenq, the 'Man of Susa' entering Egypt. Shushinak is the national deity of Elam, worshipped at Susa, and was also a great deity among the Persians. The attribution of Libyan descent to Sheshenq is due to a misreading of the genealogy of Horpasen. His name labels his origin plainly. Further, owing to the practice of hepatoscopy, a Babylonian connexion has been suggested for the Etruscans. Now the horned head-dress of divination, the vases of offerings in Etruscan tombs in the shape of a cone with two globes over it, and other evidence point to a middle Asian origin for the Etruscans, and, it is suggested, link them up with the westward movement of Turkomans, of which evidence is found at Gerar, and of which the coming of Sheshanq to Egypt formed part.

THE EXTERMINATION OF THE HEATH HEN.—The heath hen of America (*Tympanuchus cupido*), a near relative of the prairie hen which abounds on the prairies of the Mississippi valley, provides one of those problems of casual extermination which man seems powerless to stay. Fifty years ago the heath hen was a common bird on the island of Martha's Vineyard, to which it was confined. But about fifteen years since its numbers were reduced with remarkable suddenness. Attention was directed to the danger and thousands of dollars were spent in an effort to protect the birds. We now learn from a *Daily Science News Bulletin*, issued by Science Service, Washington, D.C., that even so late as 1916 there still survived about 1000 heath hens on the island reservation, and fears of their extinction were allayed. Then, just at the time when the hens were sitting on their eggs, a disastrous forest fire swept over the area, causing the loss of the year's brood as well as of many of the females. It is said that the inbreeding of the few surviving birds weakened the stock, which became subject to some of the common poultry diseases. Two years ago ornithologists were able to find only 30 specimens on the island; in a year the number was reduced to nine, a little later to three, and then to two. Now only a single specimen is known to exist—the heath hen of Martha's Vineyard is virtually extinct.

AN ALLEGED ANTHROPOID APE EXISTING IN AMERICA.—A discovery of extraordinary interest is that recorded by Dr. George Montandon in *La Nature* of May 11, where he describes from a photograph, which is reproduced, a supposed anthropoid ape from South America. A pair of the apes was seen by M. François de Loys in the virgin forests on the borders of Colombia and Venezuela, and the female was killed. It measured about 1.6 m. in height, and, as the photograph shows, had a distinctly human appearance. Moreover, the beast had no tail, and its teeth are said to have numbered 32, although, most unfortunately, the skull was afterwards damaged during the expedition and was eventually lost. On the strength of these characters, and particularly of its size and appearance, Montandon regards the creature as a new anthropoid ape related to the gibbons but bearing a resemblance in its coat and in the proportions of its limbs to the orang-utan. Accordingly he names it *Ameranthropoides loysi*, after its discoverer, and makes use of its presence in America to support his theory of the parallel development of anthropoids in America, Asia, and Africa. On the whole, in view of the scanty evidence, we prefer the caution of Prof. L. Joleaud, who in a subsequent paper in the same number of *La Nature* suggests that the new monkey is probably not a true anthropoid ape, but a specialised relative of the spider monkeys (*Ateles*).

ANATOMY OF A FŒTAL AFRICAN ELEPHANT.—Dr. N. B. Eales (*Trans. Roy. Soc. Edin.*, vol. 56, Pt. I, 1929) completes her study of the African elephant based on the examination of a well-grown fœtus. Previous parts dealt with the anatomy of the head and with the body muscles. The final part deals with the remainder of the organs. The most interesting feature in the anatomy of the elephant is the reduction of the pleural cavities shortly after birth by the ingrowth of trabecular connective tissue from the thickened costal and dorsal pleura. The result of the obliteration of the pleural cavities is to reduce costal movements during breathing to a

minimum and to make respiration in the elephant largely diaphragmal The elastic tissue helps to control the powerful diaphragmatic movements so that the air is not sucked too violently through the long nasal tubes The diminution of the collapsing power of the lungs consequent on their adherence to the walls of the chest has rendered intra pulmonary cartilages unnecessary In the light of her investigations, Dr Eales discusses the relationships of the two living species of the Proboscidea, and the affinities of the group as a whole She agrees with the view of the palæontologists that the African and Indian elephants should be placed in two distinct genera *Elephas* (Indian) and *Loxodonta* (African) The characters of the two genera are summarised and the view adopted that they belong to different lines of descent Discussing the affinities of the Proboscidea as a whole, Dr Eales shows that their characters bear evidence of affinities with the stock from which sprang the rodents Sirenia Hyracoidea and the primates, and that their nearest relatives are the Sirenia and the Hyracoidea The Ungulates are not near them in descent She therefore supports the modern view that the Proboscidea should be elevated to the rank of order and removed altogether from the Ungulata

RECLAMATION OF MOSS LAND —Although much work on reclamation of moss land has been done the essential principles of the treatment have never been properly established Some experiments, described by J Gillies (*Scottish Journal of Agriculture* 12, p 126), have recently been carried out on a large tract of this type of land in Dumfriesshire and some fundamental results obtained Before any reclamation by manurial or other treatment can be attempted effective drainage is essential Dung was the best type of manure for the purpose but it would be difficult to obtain in sufficiently large quantity for work on a large scale Gradual improvement might however, be secured by grazing stock introduced at intervals from fertile land For correcting acidity various forms of lime are suitable but they all proved of little value unless phosphate was also supplied the commercial grades of basic slag, mineral phosphate, and superphosphate are the types of phosphatic fertiliser most likely to prove of economic value Potash and quick acting nitrogen on the other hand, produced no visible improvement Direct seeding with grass and clovers in July yielded very good results if manures were supplied, particularly where dung could be given Germination, however, failed completely on untreated moss or where lime only was added Care was necessary to avoid overshadowing of the introduced species by the natural moss in the early stages of growth, tramping by stock or any other method which tended to consolidate the surface being very beneficial Red and white clovers, cocksfoot, Italian and perennial rye grass, tall and meadow fescues all germinated freely and were easily established Rose bay willow herb is a serious trouble in any reclamation work, and if strong measures are not taken to suppress it, the moss land may merely change to an equally valueless tract of willow herb

HYBRIDISATION OF THE MOLLUSK *CERION* —Dr Paul Bartsch, Curator of Mollusks in the U S National Museum, has for some years experimented in hybridisation with various species of *Cerion* In August 1928, whilst visiting the Tortugas Laboratory, he examined his enclosures in which had been placed young individuals of *Cerion viaregis* and *Cerion incanum* and succeeded in finding one adult which he claims to be a perfect hybrid (Year Book No 27 of the Carnegie Institution of Washington, 1928) Criticism was expressed after the original crossing experiments, because Dr Bartsch had employed large groups (500 individuals), and it was suggested that the organisms claimed to be crosses were possibly mutations of one of the two species involved To settle this point restricted areas (cages or islands) were used one virgin individual of each of the two species being placed in each isolated area There was a large mortality, but in one cage the adult hybrid was found This is identical with those assumed to be hybrids in the mass experiments a result which was to be expected as in no colony of *C viaregis* nor *C incanum* has any individual appeared comparable in appearance to the hybrids in question It is to be hoped that more of these interesting forms will be forthcoming

THE BREAD FRUIT OF TAHITI —It is unusual in a modern botanical monograph to find a description of thirty two varieties of a plant species which contains no scientific names The bread fruit is usually regarded as a cultivated form of *Artocarpus incisa* but according to Raoul the name bread fruit should not be attached to the wild tree of Malaysia with fertile seeds described by Linnæus with this Latin name, but should be restricted to the cultivated tree of Oceania, for which no other Latin name is at present available Gerrit Parmile Wilder describes thirty two varieties of this tree found growing in Tahiti and Moorea, the fruit and foliage of each variety being illustrated by photographs in *Bulletin* 50 of the Bernice P Bishop Museum One of these varieties Huora produces true seeds but all are propagated vegetatively usually by root cuttings This monograph describes fully the native method of preparing the fruit for the table, and the value assigned by the natives to the edibility of the different varieties The author makes the interesting comment that he noted no insect fungus, or other pest upon the bread fruit tree which has been in cultivation on these islands long before it was first seen by Europeans in the Marquesas in 1595

VIRUS DISEASE OF PLANTS —Recent work in Queensland Australia, with which Prof E J Goddard has been associated, seems to have demonstrated beyond doubt that the economically important disease of the banana known as bunchy top is a virus disease with an aphis vector An account of further work upon this disease, with suggestions as to its control, is given in Vol 2 No 1, of the *Journal* of the Council for Scientific and Industrial Research of the Commonwealth of Australia Prof Goddard has drawn upon his experience in this investigation in his presidential address to the Royal Society of Queensland, published in Vol 40 No 1, of the *Proceedings* of the Society He evidently inclines to the view that the virus will be found in the category of living organisms, ultra microscopic in size, and therefore presumably forming an intermediate step between the molecular organisms of the inanimate world and the cellular organisms of the visible animals and plants He does not deal, however, with one puzzle which this point of view presents to the investigator If such ultra microscopic forms of life exist, why are they not to be found leading a saprophytic or even an autotrophic existence? Until now, attempts such as have been made by Hugo Miehe (*Biolog Centr*, 43 1924) to cultivate such ultra microscopic saprophytic organisms have failed to produce any evidence of their existence

DIFFERENTIATION IN THE SILL OF PIGEON POINT — A valuable study by F F Grout of the association of anorthosite and granite with dolerite in the great 'diabase' sill of Pigeon Point, Minnesota, appears in the *Bull Geol Soc America*, vol 39, 1928, p 555 A

chilled doleritic roof phase intervenes in most places between the acid differentiates and the quartzite roof Locally this phase contains abundant phenocrysts of labradorite, and these pass here and there into masses of anorthosite These light masses apparently rose in the magma at an early stage because of their lower specific gravity Some assimilation of quartzite by the magma is indicated but it is suggested that the granite was probably formed essentially by differentiation, with assimilation as a merely subsidiary factor The occurrence of granite at Pigeon Point is ascribed to the unusual thickness of the sill (250 700 ft) which allowed ample time during cooling for differentiation to occur The composition of the average dolerite magma is such that granite could be formed from it by crystallisation or by the separation of partially miscible fractions in about the proportions actually found at Pigeon Point Numerical data indicate that probably much less than a quarter of the total granite was due directly or indirectly to assimilation of sediments

TRANSMISSION OF SOUND WAVES IN THE EARTH —The solution of the problem of underground communication through earth strata would be of great value to miners Unfortunately its solution offers great difficulties The ideal method should enable miners to communicate no matter the nature of the strata, whether they are water bearing or not and also whether they are broken up by old workings The apparatus must be cheap light, and able to withstand rough usage A large number of experiments have been undertaken by the United States Bureau of Mines to find out the best way of communicating between miners entombed by a disaster and persons on the surface As many of the bituminous coal mines in America are comparatively shallow, even a partial solution would be of value to them In *Technical Paper*, No 433, of the Bureau of Mines, experiments on communication by L C Ilsley, H B Freeman, and D H Nellers are described Owing to the great developments taking place in radio it was hoped that by this means communication could be established The tests were made at the Bureau s experimental mine in Pennsylvania Vertical antennæ were found to give the best results, but on the whole radio methods were found to be of little practical value A promising method discovered was to connect the source of electrical energy (two dry cells) between a point on one side and a point on the other side of the coal seam Some of the paths of current flow spread out to the surface and could be picked up by a telephone satisfactorily by choosing suitable earths It was found, however, that this 'roof to rail method was only practicable for the transmission of signals from the surface into the mine and was therefore only a half solution Tests made with a geophone—an instrument which converts the earth waves made by hammering on the rock into an air wave which is heard in the ear as sound—gave good results The simplicity of this method and of the requisite apparatus is greatly in its favour

TEXTILES AS INSULATORS —The usefulness of industrial research is well shown in an article by A C Walker on "Textiles as Insulators", which appears in the *Bell Laboratories Record* for April Silk has been used for many years for insulating conductors owing to its much higher insulation resistance than cheaper fibrous materials like cotton The fact that the insulation resistance of textiles is greatly diminished when moisture is absorbed, suggested that a research on the effect of moisture on textiles might discover methods of treating them which would improve their electrical properties It was found that the continued application of voltage sometimes increased the insulation resistance a hundredfold This was traced to the partial removal of electrolytic impurities The most significant evidence of the importance of electrolytic impurities in silk, wool, cotton, and other textiles is the great improvement in their electrical qualities due to thorough washing with water It was found that cotton washed with water from Lake Michigan had higher insulation resistance than cotton washed with distilled water in the laboratory A saturated solution of magnesium carbonate was then used with encouraging results Washing the cotton with a little calcium sulphate in it gave as satisfactory results as using water from the lake As a result of the research the insulation resistance of cotton can now be improved by simple washing processes to such an extent that its use as a substitute for unwashed silk for telephone cords has been approved It is estimated that for this purpose alone the annual saving effected in manufacturing costs to the Bell Company is about one hundred thousand pounds

EFFECT OF DRYING ON THE PROPERTIES OF BENZENE —The effect of intensive drying on the physical properties of benzene has been re investigated by Briscoe Peel and Robinson whose results are described in the *Journal of the Chemical Society* for March Baker s previous conclusion that the density of benzene does not change upon drying has been confirmed not only for the liquid as a whole but also for the various fractions obtainable by distillation After drying for sixteen months there did not appear to be any definite change in the surface tension, and any change that may have taken place would seem to be in the direction of a decrease Baker, however, found a considerable increase after a year s drying and attributed it to a change in the degree of association The reason for this discrepancy is not apparent and the experiments are being continued

CHEMICAL APPARATUS —Messrs Griffin and Tatlock, Ltd , have issued their new catalogue of chemical apparatus, No 12A, as an attractive and well illustrated volume of close on a thousand pages The firm, which combines the former businesses of J J Griffin and Sons, Ltd , and Baird and Tatlock, Ltd , is established in London, Glasgow, Manchester, Edinburgh, and Liverpool The volume is divided into 12 sections which are further classified for convenience in the list of contents The usual fittings and furniture of chemistry laboratories are illustrated not only with pictures but also with model plans and sections A special feature of the Balance Section is the Christian Becker chainomatic balance, the action of which is fully described In the section for physical chemistry will be found apparatus for measuring osmosis, surface tension, etc , and also pyrometers and various kinds of electrical appliances A section on micro analysis opens with references to standard works where complete descriptions of methods of work will be found The apparatus is specially designed for the methods of Pregl and Dubský A large selection of the well known Reichert microscopes is minutely described in the optical section, which also includes refractometers, spectrometers and polarimeters with various accessories, as well as optical benches, mercury vapour lamps, selenium cells, etc , and the Bausch and Lomb projection apparatus for which the firm acts as sole agent Meteorological appliances, laboratory machinery, and apparatus designed for the special methods of assaying used in many different industrial processes form a prominent feature of the catalogue At the end there is a fairly long list of chemical and technical books and of Kahlbaum's pure chemicals

Systematic Investigation of the Oceans

AN international oceanographic conference was held in May 1928 in Berlin to commemorate the centenary of the Gesellschaft fur Erdkunde, which has published a series of papers dealing with recent and imminent expeditions[1] Most of these naturally deal with the results obtained by the *Meteor*, but articles also describe the work of the *Carnegie*, of the little Norwegian auxiliary ketch *Armauer Hansen* in the north east Atlantic, and the aims of the new Dutch Expedition to the East Indies in the *Willebrord Snellius*

As these articles are for the most part summaries of methods used and results achieved, they cannot be condensed into a short review, but the following notes on various points in this symposium may be of general interest

Numerous samples of sea water collected by the *Meteor* in the Atlantic were analysed for gold by the method due to Haber, whereby the gold in the water is adsorbed on a precipitate of lead sulphide which on heating with lead formate and boric acid leaves a minute bead of gold This is picked out from the crucible and measured under the microscope

An ingenious method was used to collect the small amount of lead sulphide, about 40 milligrams in each litre of sea water The full flask was inverted over a crucible also containing water and the whole spun in a centrifuge, when the lead sulphide collected at the bottom of the crucible To prevent loss of water in handling, the top of the crucible was covered with a rubber cap

The plankton rich upper layers were found to be richer in gold than the water below, much of this being adsorbed on, or contained in, the organisms The quantity varied from about $\frac{1}{100}$th milligram of gold per cubic metre to a third of this amount, or less in the deep water

The greater part of the scientific work of the *Meteor* centred around depth and physical measurements, from which to deduce the oceanic circulation from the internal field of force produced by differences in density, from the general distribution of salinity, and from direct current measurements For the first time these were successfully made from a ship at anchor in mid Atlantic where the depth was over 4 kilometres For this purpose stocked anchors weighing a quarter of a ton and a tapered wire cable 7½ kilometres long were carried The circumference of the wire cable at the anchor end was 3 6 cm and at the end made fast to the winch 5 cm

The temperature measurements at various depths were made with reversing thermometers, every pre caution being taken to attain the greatest possible accuracy In order to avoid error in reading due to parallax—a matter of very real difficulty on board a small ship in rough weather—the thermometer tubes were ground semicircular in section, with the bores close to the flat face upon which the graduations were marked The readings were carried to the third place of decimals, the graduation being in 0 05°

Only general conclusions regarding circulation in the Atlantic have yet been published, the mass of data and calculation for the application of Bjerknes' theory is in process of being worked up

An account of the biological survey by E Hentschel includes a chart showing the number of plankton organisms present per litre of surface water (Fig 1)

The effect of water rising from below and bringing nutrient salts to the upper layers, where there is sufficient light for plant growth, is clearly shown along the west coast of Africa The same effect is also shown in lower latitudes due to convection currents and unrestrained turbulent motion unchecked by a discontinuity layer

The chemical observations by H Wattenberg are of particular interest The distribution of phosphates and nitrates and the relation of these nutrient salts to the density of plankton in the south Atlantic confirm and extend previous investigations in more limited areas The distribution of dissolved oxygen was found to be regular and to reflect the circulation in the deep water, saturated cold water falling in high alti-

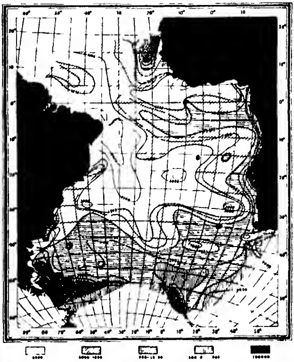

FIG 1—Plankton content of the surface water of the Atlantic, showing number of organisms per litre of water From Verhandlung der ozeanographischen Konferenz

tudes and filling the depths of the oceans, overlaid by water layers of less oxygen content in lower latitudes The minimum occurs at about 200 metres in the tropics, where a relatively thin warm and light layer lies like oil on the heavier water below, mixing by convection is hindered, and the supply of oxygen is cut off from above This minimum layer appears to be the graveyard of plankton organisms where oxygen is used up during their decay The presence of 5 to 6 c c of oxygen per litre in the deep water of the oceans indicates its origin in those latitudes where the surface water is at a temperature where more oxygen is needed for saturation, and where in winter convection currents can extend deep into the sea

The distribution of dissolved calcium carbonate in the sea is peculiar In the upper water layers of the tropics values indicating 50 per cent over saturation are indicated, below this the main mass of water is under saturated, less so near the bottom, where calcium carbonate is apparently dissolving out from the calcareous skeletons of dead organisms The actual quantity of calcium in solution, however, is considerably less in the upper layers, where it is utilised to build up the skeletons of such organisms

[1] "Verhandlungen der oceanographischen Konferens veranstaltet von der Gesellschaft für Erdkunde zu Berlin anlässlich ihrer Hundertjahrfeier." Berlin, 1928.

Closed Carbon Chains in Organic Chemistry

PROF W H PERKIN chose 'The Early History of the Synthesis of Closed Carbon Chains" as the subject of the first Pedler lecture, which he delivered before the Chemical Society on May 30 It was he said, very difficult to appreciate the fact that not more than fifty years ago the idea was firmly fixed in the minds of chemists that organic compounds must be sharply divided into the group having open carbon chains and the group having six membered rings The lecturer gave an interesting account of his discussions as a young student, with Victor Meyer and Baeyer regarding the possibility of preparing compounds containing rings composed of three, four or five carbon atoms and of his resolve to prosecute researches in that direction

The first step consisted in the condensation of trimethylene bromide with the sodium derivative of acetoacetic ester followed by hydrolysis whereby a product then believed to be acetyltetramethylene carboxylic acid but afterwards shown to be methyldihydrohexonecarboxylic acid, was obtained Before the erroneous interpretation had been corrected however the new method was vigorously developed in various directions, a substance which, indeed, proved to be tetramethylenecarboxylic acid being obtained in 1883 by the action of trimethylene bromide on the sodium derivative of malonic acid, followed by hydrolysis and elimination of carbon dioxide

Two years previously Markownikoff and Krestownikoff had obtained an acid which the lecturer and E Haworth afterwards proved to be *trans* tetramethylene 1 3 dicarboxylic acid, it was remarkable that this earlier observation attracted little attention at the time, and remained undeveloped Experiments on the action of ethylene bromide in place of trimethylene bromide on the sodium derivatives of acetoacetic ester and malonic ester brought the lecturer into conflict with Fittig, who with his pupils was at that time investigating the conditions of formation and the properties of lactones Prof Perkin gave a brief account of the evidence which led to the recognition of the formation of acids derived from trimethylene

The next step was to devise a method for the preparation of a derivative of the five carbon ring Tetramethylene bromide was then unknown, but ten years later it was obtained accidentally during the preparation of pentamethylene bromide, on condensation with the sodium derivative of malonic ester it readily yielded pentamethylenedicarboxylic ester, this on hydrolysis and elimination of carbon dioxide affording the long sought pentamethylenecarboxylic acid Similarly, hexamethylenecarboxylic acid was synthesised from pentamethylene bromide, and was shown to be identical with hexahydrobenzoic acid resulting from the reduction of benzoic acid In the meantime, an alternative method for the synthesis of the five carbon ring had been devised in 1885, the disodium derivative of pentanetetracarboxylic ester was treated with bromine, the resulting pentamethylenetetracarboxylic ester then affording pentamethylene 1 2 dicarboxylic acid The demonstration of the stability of the five carbon ring confirmed the views which Baeyer had, but a few months previously developed in his Spannungstheorie'

Finally, the lecturer referred to the syntheses of hydrindene and tetrahydronaphthalene, published conjointly with Baeyer in 1884 Interaction between *o* xylylene bromide (which proved troublesome on account of its severe effect on the eyes) and malonic ester proceeded exactly as Baeyer predicted

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The Fauna of Scotland during the Ice Age.

IN his recently published presidential address to the Royal Physical Society of Edinburgh (*Proc*, vol 21 Part 4, February 1929) Dr James Ritchie discussed the Ice Age in Scotland in its faunistic bearings While Scotland must have shared in some degree the fluctuations of climate which have left traces so marked on the neighbouring shores of continental Europe, the earlier fluctuations either left no material remains or these have been removed by subsequent glaciation, for there is no faunistic evidence of the long series of changes which represents the early ice age or *altdiluvium* of continental geologists The Scottish Ice Age exhibits but a relatively short section of the Pleistocene glacial epoch

The remains of early glacial animals in Scotland are extraordinarily scanty, but they belong to the most important of all the animals as indicators of the period of their sojourn—the mammoth, the woolly rhinoceros, and the reindeer The association of these three animals indicates a period corresponding to the Third Terrace of the Thames Valley The mammoth and reindeer remains of Kilmaurs were overlaid by an extensive deposit of boulder clay, indicating conditions of ice covered land in which even such sub arctic animals could not have survived Their appearance in Scotland therefore must date to a preceding warmer period which was followed by a major glaciation

The known distribution of the mammoth in Scotland extends from Berwickshire through Mid lothian to Lanarkshire and Ayrshire Northward migration of the mammoth may have been prevented by a water barrier formed by the junction of the estuaries of the Forth and Clyde Such a condition in the midland valley would be accounted for by a relatively slight subsidence of the land Representative animals of the later glacial faunas have been found in Scotland only in isolated spots, with the exception of the fairly extensive faunas first discovered by Drs Peach and Horne in limestone caves near Inchnadamph, now being further explored by Dr Ritchie, Mr J E Cree, and Mr J G Callander

The oldest fauna so far discovered appeared after the cave riddled hill, more than 1000 feet above sea-level, had been set free from an ice cap which left enormous deposits of silt in the inner cave, and is an arctic fauna containing scarce remains of reindeer, many arctic rodents, the arctic wolf, lynx, and a very large bear A considerable period must have elapsed before the second fauna made its appearance, when the animal remains became involved in streams flowing off the valley glacier this fauna was predominatingly a reindeer fauna, remains of more than 400 individual reindeer having been discovered in a single cave of relatively small size There *is* no trace here of modern Scottish animals These appear in a higher layer which contains for the first time remains of red deer and, on account of the skeletal character and mode of burial of human remains in it, may be regarded as belonging to the period of Azilian culture, between the Palæolithic and Neolithic Ages.

University and Educational Intelligence

BIRMINGHAM.—The Mason chair of botany made vacant by the death of Prof. R. H. Yapp, has been filled by the appointment of Prof. Walter Stiles, professor of botany in the University of Reading. Prof. Stiles is well known for his work in plant physiology and on the cold storage of food. He has made numerous contributions to knowledge of cell permeability and photosynthesis.

CAMBRIDGE.—J. C. Burkill, Peterhouse, and P. A. M. Dirac, St. John's, have been appointed university lecturers in mathematics.

G. Anrep has been reappointed university lecturer in physiology, and H. Banister lecturer in experimental psychology.

R. A. Webb has been reappointed demonstrator in pathology and H. E. Tunnicliffe demonstrator in physiology.

The Council of the Senate recommends the adoption of the following regulations for the A. W. Scott fund:

I. The money received from the bequest of Prof. A. W. Scott for the furtherance of physical science shall be separately invested and shall constitute a fund called the A. W. Scott fund.

II. The income of the fund shall be applied as follows:

1. A short course of annual lectures shall be instituted in the physics department, and a sum of £100 shall be paid to the lecturer.

2. The head of the department may make grants, not exceeding a total of £150 in any financial year, to necessitous research students working in the Cavendish Laboratory.

3. A sum of £50 shall be retained in the fund each year, and money so accumulated may at any time be used by the head of the department in defraying the expenses of occasional small scientific conferences to be held in the laboratory.

4. The remaining income of the fund shall be paid into the departmental fund of the Cavendish Laboratory for general purposes.

The Rouse Ball studentship at Trinity College, founded for the purpose of enabling a student to study mathematics or the application of mathematics in a foreign university or school, has been awarded to W. R. Andrews.

On June 4 honorary degrees were conferred upon Sir Kynaston Studd (Lord Mayor of London), Prof. Langevin, Sir Frank Dyson (the Astronomer Royal), and Prof. Beazley.

The Appointments Committee of the Faculty of Agriculture and Forestry will shortly proceed to appoint (1) a university lecturer in agriculture to give instruction in crop husbandry, and (2) a university lecturer (Gurney lecturer) in forestry to give instruction in forest botany. Particulars may be obtained from Prof. T. B. Wood, Department of Agriculture, University of Cambridge.

LEEDS.—The Senate has awarded the degree of doctor of science to Mr. J. H. Birkinshaw and Mr. A. J. V. Underwood. Mr. Birkinshaw's thesis was entitled "Studies in the bio-chemistry of micro-organisms"; Mr. Underwood submitted a series of papers under the general title of "The application of mathematical methods to some engineering problems".

LONDON.—The degree of D.Litt. has been conferred on Dr. F. A. P. Aveling, University reader in psychology, for a Thesis entitled "The Psychological Approach to Reality".

Prof. John Coatman has been appointed as from Aug. 1, 1929, to the University Chair of Imperial Economic Relations tenable at the London School of Economics.

Calendar of Patent Records

June 17, 1783.—John Fischer, mechanic, of London, is the first patentee of a pedometer, his patent, sealed on June 17, 1783, being for "a geometrical and pedometrical watch which not only answers the purposes of a common watch, but is also distinguished by showing on the dial every step the walker makes and by measuring the distance". A combined pedometer and watch of this type made a few years later, but not by Fischer, is in the South Kensington Museum.

June 18, 1823.—Great economy and improvement in the bleaching industry resulted from the patent granted to William Southworth for a machine to hang out wet fabric in the tenter house and take it up when dry, the specification of which was enrolled on June 18, 1823. This was the first successful application of machinery to this purpose, and the invention was widely adopted. The life of the patent was prolonged for five years from 1837 in the name of E. Haworth.

June 18, 1849.—The Bourdon pressure gauge derives its name from Eugene Bourdon, who obtained a French patent for the instrument for fifteen years on June 18, 1849. An instrument acting on the same principle was invented about the same time by R. E. Schinz, a railway engineer of Cologne, as a gauge for locomotives, and was patented in Germany by C. J. Rahskopf, a watchmaker of Coblenz, in March of the same year. The rights in Bourdon's English patent were acquired by Messrs. Dewrance, of London.

June 20, 1801.—The lithographic printing process was patented on June 20, 1801, by Alois Senefelder, a native of Prague living in Germany. Senefelder brought the art to great perfection, and in 1818 published instructions for using it.

June 20, 1840.—Samuel Morse patented his electric telegraph system in the United States on June 20, 1840, and the first commercial telegraph was opened between Baltimore and Washington in 1844.

June 21, 1889.—To William Friese Greene, a London photographer, must be awarded the honour of having first introduced a practical camera capable of taking an unlimited number of photographs in rapid sequence upon a band of sensitised celluloid film and suitable for subsequent reproduction in the form of a moving picture. His patent was taken out in conjunction with Mortimer Evans and is dated June 21, 1889. The first moving picture taken by Friese Greene was that of the traffic at Hyde Park corner, and it was shown on the screen at a meeting of the Royal Photographic Society in 1890.

June 22, 1839.—On June 22, 1839, Abel Morrall, a needle maker of Studeley, was granted a patent for burnishing the eyes of needles by threading them upon a roughened steel wire stretched in a frame and caused to revolve or to move backwards and forwards. The needles are thus made to vibrate upon the wire, and the eyes are very effectively smoothed. Up to that time there was no method of making the elongated eyes smooth, and the patent, which was acquired by Messrs. Bartlett of Redditch, became a very valuable one.

June 22, 1906.—Low temperature carbonisation of coal and the production thereby of a smokeless fuel dates from the work of Thomas Parker, engineer, of Wolverhampton, who patented his process on June 22, 1906, and introduced the new fuel to the public under the name of "Coalite". Plants were erected at Plymouth gas works and later at Barking, but commercial success was not at that time achieved, and it has required many years of research to make coalite a marketable product.

Societies and Academies

LONDON

Geological Society, May 8.—F. M. Trotter: The glaciation of eastern Edenside, the Alston Block, and the Carlisle Plain. Three glaciations separated by intervals have been recognised. The ice of the first or Scottish glaciation deployed from the Southern Uplands, swept across the Carlisle Plain, one stream continuing eastwards, the other advancing up Edenside, where it was joined by a stream from the Lake District. Exposures of the ground moraine of this glaciation are rare, and in eastern Edenside the moraine is in places overlaid by a series of contorted laminated clays, etc. These clays are in turn overlaid by the drifts of the second or main glaciation, when eastern Edenside was occupied by Lake District ice and Cross Fell ice. Because of the presence of Scottish ice on the north and ice from Howgill and Wild Boar Fells on the south, Edenside became congested with ice. The surface level of the ice rose to 2200 feet at least, and probably higher. The retreat of the ice front after the maximum of the main glaciation can be traced stage by stage. The last glaciation was the renewed advance of the Scottish ice across the Carlisle plain, up to an altitude of 400 or 500 feet O.D. At its maximum extension, and during its retreat, this glacier dammed up glacier lakes which drained south-westwards.—J. A. Douglas: A marine Triassic fauna from eastern Persia. An account of the discovery by Mr. R. C. Jennings and Mr. K. Washington Gray, geologists of the Anglo-Persian Oil Co., of a marine Triassic fauna in the district of Naiband. Comparison with other Triassic outcrops suggests an extension of the Triassic Tethys into Persia in Carnic times, and again at a later stage, in the Rhætic period. During the intervening Noric epoch, however, communication with the Mediterranean province was severed, while species characteristic of the Trias of the East Indies make their appearance in great numbers. There is little evidence for migration having taken place between the two areas along the 'Himalayan route' and it is suggested that the continental barrier of Gondwanaland was breaking up into an archipelago of islands.

Royal Meteorological Society, May 15.—J. Edmund Clark, I. D. Margary, R. Marshall, and C. J. P. Cave: Report on the phenological observations in the British Isles, December 1927 to November 1928. The year 1928, considered as a whole, differed but slightly from the average for 35 years. We think of the year as sunny, but the dull spring balanced brilliancy in January, July, and September; so, too, the bitter December and chilly June were offset by the wonderful warmth from January to April, with only occasional slices of cold. December checked the hazel, despite January, making it flower at the average date; coltsfoot came early. The horse chestnut flowered two days instead of six earlier than the hawthorn. Migrants, despite some remarkable premature records of swallow, chiffchaff, and cuckoo, averaged only a couple of days early. But this fully suffices to make the lines of equal appearance dates (isophenes) shift markedly northwards compared with 1927.—D. Brunt: The index of refraction of damp air, and the optical determination of lapse rate. The correction to the index of refraction to allow for the presence of water vapour is given. Variations of humidity give results which cannot be distinguished optically from variations of temperature.—J. Reginald Ashworth: The influence of smoke and hot gases from factory chimneys on rainfall. In a manufacturing town such as Rochdale, the combustion of large quantities of coal must produce an upward current of hot air which is probably sufficient to influence the rainfall. The variation of the rate at which rain falls agrees very closely with the fluctuation of smoke emission as tested by the average number of soot particles deposited from the air each day of the week.

DUBLIN

Royal Dublin Society, May 28.—J. Joly: Bi-radiant needles for use in the radioactive treatment of tumours. These needles, like those developed by the author in collaboration with Dr. Walter Stevenson in 1914, are hollow, so as to contain radium or its emanation. They are, however, divided vertically into half-needles differing in density or thickness so that rays issuing from opposite sides of the needle are unequally screened. It is therefore possible to control the intensity of radiation in different directions. Thus the natural selective effect which is believed to be responsible for the success of radio-therapy, may be enhanced by the orientation of the needles; the surrounding healthy tissues receiving definitely weaker radiation than the body of the tumour. Details respecting security against rotational movements of the needle when *in situ*, their various forms, and mode of construction are given.—W. R. G. Atkins and H. H. Poole: (1) Photo-electric measurements of illumination in relation to plant distribution. Pt. 2. Using portable galvanometers and blue-sensitive vacuum sodium photo-electric cells of the Burt type measurements were made of the daylight factor (δ) at various points in a garden; δ may be as low as 1.3 per cent under laurel bushes and holly, where only ivy straggles. *Scolopendrium vulgare* may thrive with $\delta = 2.2$ per cent. (2) The photo-electric standardisation of an uranyl oxalate method of daylight photometry. By exposing 10 c.c. of solution in six-inch quartz tubes it was found that from 0.183 to 0.236 c.c. of N/10 oxalate was destroyed per thousand metre candles per hour. The illumination was measured by a Burt cell. In noon July sunlight 85 mg. oxalic acid may be destroyed per hour, and the daily variation in this rate was studied. (3) The photo-chemical and photo-electric measurement of the radiation from a mercury vapour lamp. The uranyl oxalate method, the fading of methylene blue, the production of nitrite, and the Burt sodium cell were used, in conjunction with erythema tests, to measure the radiation from a quartz lamp. By means of various screens it was shown that what the cell measures may be taken as an index of the therapeutic value of the radiation. The intensity reaches a minimum one minute after the arc has struck and reaches a roughly constant value, fifteen times as great, five minutes later.

PARIS

Academy of Sciences, May 6.—The president announced the death of Dr. Trabut, *correspondant* for the Section of Rural Economy.—L. Cayeux: The conditions of the Silurian sea with Graptolites in Normandy. A study of the upper Silurian as revealed by a deep boring made at Danneville, Calvados, in a search for iron ore. The Graptolite Gothlandian of Normandy offers strong evidence in favour of a phenomenon of lagunar evaporation, leading to the formation of a bed of gypsum.—Charles Richet and Mme. L. Braumann: The accelerating action of minute amounts of lanthanum salts on fermentation. The amount of acid produced by the lactic ferment is increased by amounts of lanthanum sulphate of the order of 10^{-8} grams per litre.—Gabriel Bertrand and Mlle. C. Voronca-Spirt: Titanium in phanerogam plants. Titanium is met with in all phanerogams, the

green parts, especially the leaves, containing the highest proportion of the metal Titanium has been found in plants by other workers, but its presence has been ascribed to the accidental presence of dust Precautions against such contamination have been taken —**J B Charcot** The South American Antarctic A statement of the results of French explorations, especially those of Dumont d'Urville —**Léon Guillet and Michel Samsoen** Studies of traction at high temperatures A description, with illustrations, of the arrangement of test pieces and furnace, the latter automatically controlled within 3° of 450° C Figures are given for the elastic limits of four steels —**E Mathias** Contribution to the study of fulminating matter its explosion by shock Historical summary of cases of globular lightning —**Charles Nicolle, Charles Anderson, and Pierre Hornus** A new spirochæte from a case of recurrent Moroccan fever A discussion of the relations between the spirochætes of Spain, Mansouria, and the new organism, based on the agglutination effects and partial immunities —**Constant Lurquin** The forms of extension of the Bienaymé Tchebycheff criterion —**J Favard** What is the smallest circle in the interior of which can be put all the plane convex curves of length L and surface S ?—**Bertrand Gambier** Groups of transformation and geometrical theorems —**Georges Giraud** The generalised problem of Dirichlet, complements relating to the linear case and to the non linear case —**A Angelesco** Certain polynomials of Tchebycheff —**Rolf Nevanlinna** A problem of interpolation —**R Chambaud** The bending of rectilinear pieces submitted to an eccentric force of compression —**D Wolkowitsch** A new type of spring —**P Biquard** The phenomena produced by the interposition of a metallic plate in a bundle of ultra sound waves —**Henri Chaumat** A comparison between electro static machines and direct current dynamo machines —**Henri Gutton** The dielectric constant of ionised gases —**L Bouchet** The electrolytic potentials of some metals Results of measurements of the electrolytic potential, referred to the normal calomel electrode taken as zero, are given for magnesium, zinc, hydrogen, copper, and silver —**Mlle A Serres** The magnetic properties of ferric oxide and of some ferrites above their Curie point, conservation of constant paramagnetism in these combinations —**Robert Forrer** The two Curie points, ferromagnetic and paramagnetic To obtain spontaneous magnetisation, the existence of a magnetic moment and a spontaneous orientation is not sufficient, there must be hysteresis in addition Ferromagnetism only exists below the two Curie points —**A Couder** Description of the diffraction figure at the mean focus of an astigmatic bundle —**E Sevin** The theories of the continuous X spectrum and of Compton's phenomenon Remarks on a recent communication of Décombe on the same subject —**Jean Jacques Trillat** The phenomena of orientation and of pseudo crystallisation resulting from the effect of traction in colloidal gels Results obtained by the application of X ray photography to nitrocellulose or cellulose acetate films under varying amounts of stretching —**C Pawlowski** The production of the H-disintegration rays under the α radiation of polonium The α rays of polonium are, as Schmidt has shown, capable of producing the disintegration of aluminium The H_α rays can be produced not only by α rays of a path of 3 9 cm but also by those of a path of 2 4 cm —**E Cornec, H Krombach, and A Spack** The equilibria between water and the nitrates and sulphates of sodium and potassium —**P Lebeau and A Damiens**: A new method of preparing fluoride of oxygen —**Ch Bedel** The solubility of silicon in hydrofluoric acid The variations in the solubility of silicon in hydrofluoric acid have been attributed to the state of division of the former, the experiments detailed in the present paper do not confirm this, the most important factor in the attack being the concentration of the acid —**Mlle M Cabanac** The hydrogenation of the acetals of the fatty acids The reaction is

$$CH_3\ CH(OR)_2 + H_2 = C_2H_5\ O\ R + ROH,$$

and appears to be general It constitutes a method of preparing either symmetrical or mixed ethers —**D Ivanoff** The thermal decomposition of the organo magnesium alcoholates —**Y Milon** The existence of a marine Eocene formation in the depression of Toulven (Finistère) **Bruet** A particular facies of the upper Pleocene of the valley of the Aujon (Haute Marne) —**G Delamare and C Gatti** *Indiella americana*, a hyphomycete capable of cultivation —**Jules Amar** The pulmonary *tirage* This term is applied to the expression $\pi h/p$, where π is the perimeter taken round the level of the breasts h the height of the bust, and p the weight of the body This has an average value of 124 for men and 108 for women —**Emile F Terroine and Mlle Thérèse Reichert** The influence of the salt ration on the magnitude of the nitrogen retention in the course of growth It has been shown in an earlier communication that the presence of a complex mineral ration (common salt, potassium chloride, potassium phosphate) considerably increased nitrogen retention during growth It is now shown that the constituents of the saline mixture taken singly, exert no favourable action —**E Voisenet** Divinylglycol considered as the cause of the bitter taste in the disease of bitter wine From a sample of Burgundy attacked by the disease a liquid has been isolated with a very bitter taste It has been identified as divinylglycol, $CH_2 - CH - CH(OH) - CH(OH) - CH = CH_2$ —**Georges Blanc and J Caminopetros** The duration of conservation of the virus of dengue in the Stegomyas The influence of the cold season in the infecting power It has been shown that dengue is transmitted in Greece by the mosquito *Stegomya fasciata* The infected mosquitoes can live under favourable conditions at least 200 days They lose their infecting power when the mean temperature falls below 18° C, but the virus is not destroyed, since the Stegomyas again become infectious when the temperature rises above 18° C This mosquito can thus carry the infection from one year to the next

Official Publications Received

BRITISH

The Scientific Proceedings of the Royal Dublin Society Vol 19 (N S.) No 21 The Effect of Strong Magnetic and Electric Fields on the Rectilinear Propagation of γ Rays By Dr J H J Poole and A G Clarke Pp 265 271+plate 16 (Dublin Hodges, Figgis and Co London Williams and Norgate Ltd) 1s

Department of Scientific and Industrial Research Building Science Abstracts Compiled by the Building Research Station and published in conjunction with the Institute of Builders Vol 2 (New Series) No 4 April Abstracts Nos 590 824 Pp x+133 171 (London H M Stationery Office) 9d net.

Indian Central Cotton Committee Technological Laboratory Bulletin No 20, Technological Series No 15 The Effect of using either One Head or Two Heads of Drawing instead of Three Heads of Drawing in the Spinning Preparation for Spinning Tests By A. James Turner Pp. ii+18 (Bombay) 1 rupee.

FOREIGN.

Smithsonian Miscellaneous Collections Vol 81, No 9 A Second Collection of Mammals from Caves near St Michel Haiti By Gerrit S. Miller, Jr (Publication 3012) Pp. 30+10 plates. (Washington, D C Smithsonian Institution)

Smithsonian Institution Explorations and Field Work of the Smithsonian Institution in 1928. (Publication 3011) Pp. vi+198 (Washington D C Smithsonian Institution)

Bulletin of the National Research Council No 67 The Minimum Protein Requirements of Cattle Report of Committee on Animal Nutrition. Pp 84. No. 68 Transactions of the American Geophysical Union Ninth Annual Meeting, April 26 and 27 1928, Washington, D C Pp. 103. (Washington, D C National Academy of Sciences)

Diary of Societies

FRIDAY JUNE 14

ROYAL ASTRONOMICAL SOCIETY at 5 —T P Bhaskaran The Number of Stars of Different Magnitude in the Hyderabad Astrographic Catalogue Fifth Paper Zone −21 —Prof E W Brown The Planetary Theory with the True Longitude as Independent Variable

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section) (Annual General Meeting) at 5 —E Maddox Demonstration of the Cheiroscope —Miss M Dobson Velanoskiascopy a Control in the Correction of Astigmatic Defects

PHYSICAL SOCIETY (at Imperial College of Science) at 5 —W E Pretty Pressure Shifts in Line Spectra of Gases —A S M Symons and J Daley The Zeeman Effect for the Arc Spectrum of Gold —Dr W Jevons The Band Spectrum of Lanthanum Monoxide —Demonstrations by G D Preston (a) The Crystal Structure of the Allotropes of Manganese (b) The Change of Physical Properties during the Age hardening of Aluminium Alloys

DIESEL ENGINE USERS ASSOCIATION (at Caxton Hall) at 6 —C H Faris Repairs to Diesel Engine Parts by Electro deposition

MALACOLOGICAL SOCIETY OF LONDON (in Zoological Department University College) at 6

SATURDAY JUNE 15

BIOCHEMICAL SOCIETY (at John Innes Horticultural Institution Merton) at 11 45 A M —H W Kinnersley and R A Peters Observations on Carbohydrate Metabolism in Avitaminous Birds —E Boyland The Lag between Phosphate Esterification and Carbon Dioxide Evolution in Alcoholic Fermentation —H B Stent V Subramanian and T K Walker The Degradation of Succinic Acid by *Aspergillus niger* —R Scott Moncrieff The Isolation and Identification of Some New Anthocyanins —E Phillis The Sugars of Tulip Bulbs —H J Channon and G A Collinson Absorption of Liquid Paraffin from the Alimentary Tract of the Rat and Pig —T Moore The Association of Vitamin A Activity with Carotene in the Carrot Root —D I Collison E M Hume I Smedley MacLean and H H Smith The Nature of the Vitamin A Constituent of Green Leaves —H W Dudley The Isolation of Acetyl Choline from Natural Sources

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Newcastle upon Tyne) at 2 30 —R G Carruthers Burnt Outcrops of the High Main Coal at Newcastle on Tyne —*Papers open for Discussion* —Roof Control on Longwall Faces J F C Friend Diamond Boring Applied to Tapping Drowned Areas Underground F E Smyth Land Drainage H C Pawson The Laws of Motion of Particles in a Fluid R G Lunnon Boring against Workings likely to contain an Accumulation of Water or other Liquid Matter and a Method of Negotiating a Fault C H Leeds The X Ray Analysis of Coal the Radiographic Variables and their Control C N Kemp

TUESDAY JUNE 18

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (at Spa Hotel Bath) at 10 A M —Dr Margaret Fishenden and A F Dufton Heating Research at Watford 1928 1929 —At 2 30 —Demonstration of Treatment at the Grand Pump Room

ROYAL SOCIETY OF MEDICINE at 5 30 —General Meeting

LONDON NATURAL HISTORY SOCIETY (at Winchester House E C) at 6 30 —A Capleton W H Hudson the Naturalist

WEDNESDAY JUNE 19

ROYAL METEOROLOGICAL SOCIETY at 5 —Dr F J W Whipple Potential Gradient and Atmospheric Pollution the Influence of Summer Time —A J Bamford Vertical Air Currents as Measured by Pilot Balloons —Dr G Slater Studies on the Rhone Glacier 1927 The Relationship Between the Average Air Temperature and the Rate of Melting of the Surface of the Glacier

THURSDAY JUNE 20

ROYAL SOCIETY, at 4 30 —Sir Charles Sherrington Some Functional Problems attaching to Convergence (David Ferrier Lecture)

CHEMICAL SOCIETY at 8 —Prof H B Baker Manipulation in Intensive Drying —Prof W A Bone Notes on Intensive Drying of Gaseous Media —H. J Emeléus The Light Emission from the Phosphorescent Flames of Ether Acetaldehyde Propionaldehyde and *n* hexane —A J H Houssa, J Kenyon, and H Phillips The Relative Configuration of *d* β-octanol and its Dextrorotatory Halides The Interconversion of the Optically Active β octanols by a New Method

C B C SOCIETY FOR CONSTRUCTIVE BIRTH CONTROL AND RACIAL PROGRESS (at Essex Hall Strand), at 8 —Mrs C B Hodson Birth Control Clinics in the United States

FRIDAY, JUNE 21

ROYAL SOCIETY OF MEDICINE (Otology Section) (at Cambridge) at 2 —L Yates The Evolution of the Sense of Hearing —J S Tucker Localisation of Sound —S Hett, Dr A G Wells, and Dr Murray Levick Ionisation as a Treatment for Middle ear Suppuration —At 4 30 —Dr A A Gray The Application of the Principles of Maximum Stimulation to Clinical Otology —G Wilkinson Demonstration of a Model Resonator Designed to Illustrate the Mechanism of the Cochlea

ROYAL SANITARY INSTITUTE (at North East Coast Exhibition, Newcastle upon Tyne), at 2 30 —Dr H G Davison and others Discussion on The Problem of Feeding the Premature Infant —Dr E F Murray and others Discussion on The Need for a Maternity Service —Dr H. H Evers and others Discussion on The Importance of Ante Natal Supervision —At 4 30 —D Boyd and others Discussion on Eliminating the Tuberculous Cow Administrative Results at Berwick upon Tweed —D W Henderson and others Discussion on Hygienic Milk Supplies —C H. Westwater and others Discussion on Clean Milk in the Northern Counties —At 8 —Prof L E Hill Smoke Pollution (Public Lecture)

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (Annual General Meeting) (at 11 Chandos Street W), at 8 15 —Induction of New President Dr G Carmichael Low —Dr J F C Haslam Some Health Problems of British Guiana —Presentation of the Manson Medal to Sir Ronald Ross and the Chalmers Medal to Major A C Sinton

ASSOCIATION OF ECONOMIC BIOLOGISTS (Annual Field Meeting) (at Cambridge) (continued on June 22)

SATURDAY JUNE 22

ROYAL SOCIETY OF MEDICINE (Otology Section) (at Cambridge) at 9 30 A M —M Vlasto The Chorda Tympani Nerve in Otology —C S Hallpike Some Observations on Bone Conduction —A R Tweedie Demonstration of Apparatus for Control of Conversation Test

ROYAL SOCIETY OF MEDICINE (Diseases in Children Section) (at Nottingham)

PHYSIOLOGICAL SOCIETY (at Plymouth)

PUBLIC LECTURE

WEDNESDAY JUNE 19

UNIVERSITY OF BIRMINGHAM at 4 30 —Dr C Singer The Modern Spirit in Medicine (I)

CONFERENCES

JUNE 14 AND 15

SOCIETY FOR EXPERIMENTAL BIOLOGY (at John Innes Horticultural Institution Mostyn Road Merton Park S W)

Friday June 14 at 10 A M —D Ward Cutler Soil Protozoa and Bacteria Relationships

V B Wigglesworth (*a*) The Part Played by the Tracheal System of the Tse-tse Fly during the Digestion of Blood (*b*) The Functions of the Proventriculus in the Tse tse Fly

Dr R A Fisher The Experimental Examination of the Theory of the Evolution of Dominance

C Diver Reverse Mutations in *Limnaea peregra*.

At 2 15 —Prof A E Boycott and Dr J Henderson Smith The Nature of Filterable Viruses

Dr R J Ludford Vital Staining with Acid and Basic Dyes

At 4 30 —Dr M C Rayner The Practical Importance of *Mycorrhiza* to Forest Trees

A J Bennett The Changes in the Testis of the Stickleback Preceding the Breeding Season and their Relation to the Development of Nuptial Coloration

E A Spaul The Distribution of Biological Activity in the Anterior Pituitary

Saturday June 15 at 10 A.M —J B S Haldane The Bearing of Genetics on the Species Problem

F W Sansome Experiments on the Physiology of Pollen

E J Collins Some Hybrid Calceolarias

At 11 A M —Demonstrations —

Dr E J Collins Some Hybrid Calceolarias

Dr C L Huskins Cytology of Cereals and Tomatoes

M B Crane (*a*) Sterility and Incompatibility in Fruit Trees (*b*) Graft Hybrids

T Philp Flower Colour in *Papaver*

Miss D M Cayley Breaking in Tulips

Miss de Winton and Miss Pellew (*a*) Linkage in *Pisum sativum* (*b*) Genetics in *Pisum sativum*

Miss Pellew (*a*) Genetics of *Primula Kewensis* (*b*) Chimeras A New Segregation in W Bateson's Pelargonium var Mrs Mappin

Miss M A Tazelaar The Effect of Rapid Limb Growth on Neighbouring Limbs in *Talorm n carinus*

JUNE 14

INTERNATIONAL CONFERENCE ON LARGE HIGH TENSION SUPPLY SYSTEMS (at 9 Avenue Hoche Paris).

In Morning —C I Budeanu Power Factor Improvement —F Rutgers Simplified Graphical Representation of Active and Reactive Power in Vectorial Diagrams —L Gratzmuller The Conservation of Reactive Power in Electric Systems —A Iliovici Measurement of Electrical Energy and Power at Very High Voltages —G Renesson Notes on the Measurement of Electrical Energy at High Voltages —A. Barbagelata Metering and Tariffs in Three-phase Supply

In Afternoon —L C Grant Lightning and Surges on High tension Transmission Lines —R O Kapp The Selective Protection of Transmission Lines —P Traverse Investigation and Statistics on Surges in Transmission Systems —F W Peek Developments in the Control of Lightning —Barbillion and Teszner The Rôle of Condensers and Similar Devices in the Protection of Networks Against Surges Theoretical and Experimental Study —K Gotoh and Matsunaga Lightning and 154 000-volt Transmission Lines —A Iliovici Selective Protection of Networks Based on Unbalanced Currents Voltages, and Power —A Tchernycheff A New Method of Protection for Heavy current Equipment —M Walty Long distance Communication in Electric Systems —A. Tchernycheff Special Apparatus for the Protection of Long-distance Communication Lines —German Telephone Administration Measurement of the Coefficient of Mutual Induction between Two Lines with an Earth Return —T N Schnia Standardisation of International Statistics in Regard to the Generation and Distribution of Electric Power —P Rieunier Interconnexion of Systems Operating at Different Frequencies —J Kopeilowitch The Use of an Ohmmeter as a Selective Relay —L Gratzmuller Increasing the Number of Phases for a Supply to Mercury Converters, with a View to Reducing the Effect of Harmonics in a Distribution System.

SATURDAY, JUNE 22, 1929

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Editorial and Publishing Offices

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The British Patent System

ON a number of occasions in recent years attention has been directed in these columns to the importance of the British patent system from the point of view of scientific men and we have pointed out that the defects from which it suffers, whether in respect of law or of administrative machinery, ought to receive more serious consideration from the Government of the day than they have until recently obtained It has therefore been particularly gratifying to note a number of indications that the importance of this branch of the public service is coming to be recognised more adequately One of the pleasantest of these indications was the conferment in the birthday honours list, of a knighthood on the Comptroller General of Patents Mr W S Jarratt whose appointment a few years ago gave much satisfaction to those who had been contending that scientific and technical qualifications were essential to the adequate discharge of the Comptroller s duties

The report recently issued by the British Science Guild on the subject of the reform of the patent system has received general support from the Press and from a large number of interested bodies but perhaps the most interesting comments yet made upon it are those that have just been issued by the General Council of the Bar, which appointed, some time ago, an extremely strong committee to review the British Science Guild report The committee included, among others, Sir Duncan Kerly, K C (chairman) Mr James Whitehead K C, the Hon Stafford Cripps, K C, and Mr Trevor Watson, the members agree that the report of the British Science Guild ' is generally excellent, and that most of its proposals are reasonable and likely to be useful " They then discuss certain of its paragraphs in detail

The committee agrees strongly that the effect of paper anticipations ' should be restricted, that remedies against unwarranted threats should be strengthened, and that appeals from the decisions of the Comptroller of Patents should be heard by a special judge in chambers instead of by the Attorney General or Solicitor General as at present The only proposals in respect of which the committee is opposed to the Guild s recommendations are those which would extend the judicial duties of the Comptroller It thinks that the object of these proposals—namely, the mitigation of the present high cost of patent litigation—would be better achieved by (1) resort to arbitration or (2) agreement between the parties whereby the issues to be

tried in court may be narrowed down The latter of these alternatives commends itself strongly to common sense, but the former presents difficulties In a highly technical industry it is often far from easy to find an expert whose interests are entirely independent of those of the parties, and it is very much more difficult to find such an expert possessed of the additional qualification of experience in the construing of patent specifications

The recent appointment by the Board of Trade of a departmental committee, under the chairmanship of Sir Charles (formerly Lord Justice) Sargant, to consider the subjects dealt with by the British Science Guild's report, has brought the proposals for reform within the realm of practical politics These proposals have five principal aims (1) To diminish the grant of invalid patents , (2) to relieve the main patent system of the monopolies for small innovations which may be regarded as useful designs rather than inventions, and are protected in Germany by *Gebrauchsmuster* , (3) to mitigate the evils arising from the high cost of litigation , (4) to render more accessible to the public the information which is in the possession of the Patent Office , and (5) to improve in detail the efficiency of the patent system

The procedure to be adopted by the Sargant Committee has now been decided, and it appears that evidence will be received from persons having a suitable *locus standi* It is to be hoped, therefore, that the manufacturers and others whom the subject concerns will make themselves familiar with the proposals which have been put forward, in order that a widely representative body of reasoned opinion may be available to the new committee It is gratifying to know that many organised bodies have, like the General Council of the Bar, appointed responsible committees to examine the matter from the points of view which they represent, and that at its recent meeting the Council of the British Association resolved to support the recommendations of the British Science Guild

The growing importance of the patent system is indicated by the statistics disclosed in the Patent Office Report for 1928, which was published on May 31 last The volume of patent business shows a rapid increase, the number of complete specifications filed during the year, namely, 24,045, being greater by 2648 than that for the previous year The number of letters dispatched increased from 314,000 in 1927 to 331,000 in 1928, the number of patent specifications sold from 370,808 to 424,028, and the number of applications under the International Convention from 6810 to 7971 The amount received from renewal fees increased by only £5767 to a total of £283,252, but somewhat larger increases may be expected under this head as the effect of the War period passes away

It is remarkable that during the same period the total strength of the staff increased only from 696 to 698, while the strength of the examining staff increased by only 4 to a total of 240 The staffing question is a very grave one, for not only is the work of the Patent Office dangerously in arrear, but also the utmost difficulty is likely to be experienced in obtaining any additional examiners who may be required to implement the recommendations of the Sargant Committee A competitive examination for technical posts in the Patent Office was held last year and failed to attract candidates further, the cream of the examining staff is constantly being skimmed away by the offer of more lucrative appointments in industry The problem of obtaining and keeping properly qualified recruits is one of the most urgent of those which call for early solution It is not satisfactory that officials who to day are entrusted with highly confidential information, should to morrow be working for rival firms in whose employment their knowledge may be embarrassing

On the other hand, there should be no difficulty in financing considerable improvements in the machinery of the patent system without recourse to the public purse, for the annual surplus of fees over expenditure has reached the very large amount of £147,840 out of a total revenue of £544,740 , and to this surplus should properly be added the cost of maintaining the Patent Office Library, which is used by the general public and cannot be regarded as the exclusive concern of patentees The following table is of interest in this connexion

Year	Complete Specifications Filed	Surplus £	Strength of Examining Staff
1924	18,800	75,202	253
1925	19,434	88,540	241
1926	19,948	98,813	238
1927	21,397	112,939	236
1928	24,045	147,840	240

On the whole, it may be said that there is a better prospect now than at any other time during the past twenty five years of bringing the patent law and machinery up-to date The co operation of all who have serious contributions to make will be needed if full advantage is to be taken of the opportunity which has presented itself

The Beginnings of Entomology

Materialien zur Geschichte der Entomologie bis Linné Von Dr F S Bodenheimer Band 1 Pp x+497+24 Tafeln (Berlin W Junk, 1928) 2 vols, £6

ENTOMOLOGY has been called the Cinderella of the sciences If the study of insects has for long played the part of neglected sister among kindred pursuits, it cannot be denied that of late years it has held a position second to none in respect of its bionomic, economic, and hygienic importance Entomological history is, however, poor in comprehensive treatises This is remarked by Dr Bodenheimer at the outset of the present work, which, though modestly entitled ' Materials for the History of Entomology ", and stated by him to aim only at a survey, not an exhaustive presentation, is a monument of careful and industrious research, and goes far towards repairing the deficiency to which he directs attention

The earliest entomology was utilitarian, the production of silk and of wax engaged the attention of the most ancient civilised races, to the exclusion of any matter of biological interest According to Chinese tradition, silk cultivation, for the sake of clothing and of religious ceremonial, goes back to the Emperor Fu hsi at the beginning of the third millennium B C The secret of silk production was rigidly kept throughout many ages, but within comparatively recent times illustrated works, professedly based on earlier treatises, have been issued by the Chinese, giving details of the whole process Some interest in natural history is evinced by late editions of the Erh ya, an encyclopædia attributed in its original form to a writer of the sixth century B C Recognisable figures of the dung beetle, wood boring larvæ, the cicada, mantis, and mole cricket are reproduced by Dr Bodenheimer from this work

To the ancient Egyptians, as to the Chinese, the appeal of entomology was mainly utilitarian, though bees, and possibly wasps, appear as symbols so early as the period of the First Dynasty A relief from the temple of Ne user re (about 2600 B C) shows the process of extracting honey from combs after fumigation, of refining, and of sealing it in a permanent receptacle Representations of butterflies are found among Egyptian wall paintings, some of which may almost certainly be identified as *Danaida chrysippus* Egyptian pharmacology contains recipes in which insects take part, while the " Book of the Dead " has many references to insects The interest taken in the scarabæus as an emblem of the sun-god is well known, it does not appear, however, that the Egyptians were acquainted with its metamorphoses Herodotus in his book about Egypt mentions the use of mosquito curtains

Little is known of the entomology of Assyria and Babylon, but there is a cuneiform record of the importation into Assyria and acclimatisation of bees for honey and wax, sculptures and seals of these nations present good figures of flies, and of locusts preserved for food The inhabitants of Palestine were interested in insects chiefly for their useful, noxious or troublesome qualities Besides locusts, the raids of which are so vividly described by the prophet Joel, there are references in Isaiah to the ravages of the clothes moth, honey seems to have been known to the Israelites only from wild bees In later times the Talmud contains natural history items of interest

It is remarkable that among the earliest relics of European civilisation occurs the symbolising of the soul under the figure of Psyche, or the butterfly A striking reproduction of a Mycenean wall painting is given by Dr Bodenheimer, in which the death goddess, walking in a field of asphodel, is surrounded by fluttering butterflies With Homer we enter upon a new period His likening of the opposed ranks of Greeks and Trojans to swarming flies, and his similes derived from bees, wasps, cicadas, the gadfly, locusts, show powers of keen observation and poetic insight A passage in the Iliad proves that its author was aware that maggots of carrion were the offspring of the blowfly In Aristotle we meet the embodiment of Hellenic thoroughness, the principles of classification, the facts of anatomy, physiology, reproduction, metamorphosis, are minutely dealt with by him in relation to insects as to other forms of life Good natural history notes are to be found in his works, and on all these accounts the philosopher of Stagira well deserves to be known as the father of scientific entomology Among his successors, Theophrastus has valuable entomological observations, chiefly from the point of view of injury to vegetation, while Dioscorides regarded insects chiefly as ingredients in the Pharmacopœia But the biological interest started by Aristotle was never entirely lost His facts were incorporated in later treatises, and were amplified by Pliny, the eleventh book of whose ' Natural History ", devoted to insects, shows him to have been more than a mere compiler He, says our author, rather than Aristotle, gave the impulse to Gesner and Aldrovandi But the sober minded Romans generally went in for utility The entomology of Cato, Varro, Columella was of the ' economic ' variety, and even

Virgil's poetic and imaginative "Georgic" on bees had an ultimately utilitarian object.

With the advent of the Middle Ages the Hellenic love of observation and desire for scientific knowledge underwent a temporary eclipse. Such compilations as were produced tended rather to utilitarianism or to moral teaching. But from the beginning of the twelfth century may be roughly dated a revival of interest in Aristotle, preceded by Arabic influence which began to make itself felt at an even earlier date. Aristotelian science spread into western regions, especially Spain, through Arabs who derived it from Byzantium. A translation of Aristotle's zoological works into Arabic, with a commentary, had been made about A.D. 1000; much advance had also been effected by subsequent Arabic writers. A great name of this period is that of Albertus Magnus (1193-1280), Provincial of the Dominicans and Bishop of Regensburg, whose fine treatise "De Animalibus", with its faithful following of Aristotle, gained him the title of "Aristotle's Ape". The book shows evidence of original observation, and contains acute remarks on the relation of structure to function. The somewhat small portion devoted to insects, like the rest, is naturally not devoid of errors; but Dr. Bodenheimer is probably right in asserting that there is no greater biologist than Albertus between Aristotle and Réaumur.

The end of the fifteenth century witnessed the dawn of a new age in art and literature. The discovery of America, the general revival of Greek, the invention of printing and the rise of vernacular literature combined to set in motion a fresh impulse towards learning in general and the cultivation of science in particular which has gone on without a break to the present day. From this time natural science gradually disentangled itself from theological and medicinal limitations. It must be admitted that in the general revival entomology lagged somewhat behind. Its new age can scarcely be said to begin until Aldrovandi published in 1602 his "De Animalibus Insectis" in seven books, the result of fifty years' study, and the first work entirely devoted to entomology. His classification, founded on Aristotle, whose influence was still strong, is in some respects less in accordance with Nature than that of his master. But he remains a true Aristotelian, though a critic of that author's mistakes. His volumes contain excellent figures, especially of Lepidoptera, and also the first illustration of insect anatomy (the silk gland of *Bombyx mori*).

The English physician Mouffet (1530-1604) carried on and added to the compilations of Gesner and Wotton, of which he had received the drafts through Thomas Penn. Mouffet's figures of insects, which are mostly independent of Aldrovandi, are quite good. They were not published until 1634. Bacon made observations on insects, but had little or no direct influence on biological science; nor had his younger contemporary Descartes much interest in biology and its problems.

Harvey (1578-1657), who may be called with justice the founder of modern physiology, was the first of modern biologists to include invertebrates in his physiological researches. His wide conception of the 'ovum', which he took to include both larva and pupa, had the unfortunate result of leading to Swammerdam's theory of 'evolution', 'emboîtement', or preformation of the imago in the egg. Before the close of the seventeenth century Redi had disproved by experiment the theory of spontaneous generation which had held the field since Aristotle; Malpighi had published under the auspices of the Royal Society his elaborate work on the anatomy of the silkworm; and Swammerdam had executed the admirable insect dissections illustrated in his great "Bibel der Natur". A little later the pioneer microscopists Leeuwenhoek in Holland and Hooke in England had investigated and figured the compound eyes of insects, the histology of insect muscle, the structure and action of insect wings, and parthenogenesis in aphids. Goedart, a painter who took to entomology, and Lister, physician to Queen Anne, occupied themselves with the question of insect parasites. Lister was the first to establish the true life history of the parasitic wasps.

In 1705 Madame Merian published her finely illustrated work on the insects of Surinam. A little later came Vallisneri, who, in spite of his dictum that "Observation is better than Speculation", firmly supported Swammerdam's doctrine of 'evolution'. But the chief name for entomology at this period until the advent of Linnæus is certainly that of the versatile Réaumur, whose volumes of "Mémoires" contain most valuable studies in insect anatomy and physiology. The succession was carried on by Roesel and Bonnet; and before the end of the eighteenth century the binary system of nomenclature, towards which the previous work of Ray and Willughby had tended, was, in the hands of Linnæus, to make identification for the first time generally possible.

At this point the present instalment of Dr. Bodenheimer's exhaustive treatise is brought to a conclusion, leaving Linnæus and his successors to be dealt with in a future volume. Much commendation is due to the author for the way in which he has carried out his laborious undertaking, of which the

present article may be taken as virtually a summary The book is well produced and well illustrated The only printers' errors that have come to notice are a misplacement of reference letters on Plate VII, and " Bohart " for Bobart (the Keeper of the Botanic Garden at Oxford) on p 491

F A D

Modern Cosmogony

(1) *Astronomy and Cosmogony* By Sir James H Jeans Second edition Pp x+428 (Cambridge At the University Press, 1929) 31s 6d net

(2) *Eos or The Wider Aspects of Cosmogony* By Sir James Jeans (To day and To morrow Series) Pp 88+6 plates (London Kegan Paul and Co, Ltd, New York E P Dutton and Co, 1928) 2s 6d net

(3) *Cosmology a Text for Colleges* By Prof J A McWilliams Pp x+243 (New York The Macmillan Co, 1928) 10s 6d net

(1) THE publication, within a few months of a second edition of " Astronomy and Cosmogony ", replete with abstruse mathematical formulæ and priced at 31s 6d, is a noteworthy event on which Sir James Jeans may well be congratulated The demand for the book is a striking tribute to the clearness and wide appeal of the author's manner of exposition, as well as to the extent of his reputation as an authority on questions of cosmogony, for the present boom in matters astronomical, especially of the more speculative type, is by no means a sufficient explanation Naturally, within so short a time, no need has arisen for drastic alteration, although there has been more modification than the mere correction of minor errors and misprints The book has been expanded by references to various observational and theoretical results which have appeared since the first edition was written, and space has been allotted more liberally to certain problems and investigations " which ", says the author, " friendly critics thought I had dismissed too briefly in the original book " We note that among the problems and investigations thus referred to are some of those mentioned in the review of the first edition which appeared in NATURE of Aug 4, 1928 The new edition contains eight pages more than the old This is due almost entirely to additional matter, the amount of modification of the original text being negligible There is nothing that calls for special comment The former point of view is maintained without change, and the prospect it commands, though scanned in slightly greater detail in certain directions, preserves the same aspect Sir James Jeans's methods, as well as his conclusions, are highly original, and whatever may be thought of their validity, are singularly acute and penetrating It is too early yet to form an estimate of their final value, but we may say with confidence that no consideration of the subjects with which they deal can afford to neglect so important a contribution

(2) It was a happy idea of the editors of the ' To day and To morrow " series to pay some attention to Yesterday, and the choice of Sir James Jeans as historian could scarcely have been improved upon Readers of NATURE are familiar with the general character of the cosmogony which, during recent years, he has been engaged in constructing, and they will find here a clear and summary account of it in its most up to date form The book is based on the Trueman Wood lecture delivered before the Royal Society of Arts on Mar 7, 1928, and a lecture on " Recent Developments of Cosmical Physics " at the University of London on Nov 9, 1926 Both these lectures were reproduced in NATURE shortly after delivery The present volume, therefore, is to be recommended on account of its compactness rather than its novelty, and also for the illustrations of nebulæ and star clouds, of which six are excellently reproduced The book is less an argument than a description, leading, as all scientific work does, to more questions than it answers For the reasons which have led to the conclusions presented, the inquirer must be referred to Sir James Jeans's larger work on ' Astronomy and Cosmogony " It is necessary to say this because, taken alone, some of the statements appear to wear an air of confidence unjustified by the grounds on which they are based Whatever may be the reader's reaction to the views expressed, however, the reading of the book will be accompanied by unalloyed pleasure Sir James Jeans remarks that astronomy is a subject on which ' one could hardly be prosaic if one tried " We have received many proofs that this is an under estimate of human ingenuity, but if the remark be restricted to the present author we can give it whole hearted assent

(3) Prof McWilliams's book is described as " a text for colleges " Cosmology is not a subject with which we are familiar in college curricula, but it is clear from the treatment that the book is intended mainly for Roman Catholics, for the viewpoint of the Catholic Church is taken through

out It is impossible, therefore, for one who does not share that viewpoint to treat the discussion with much sympathy It does not appear to us, for example, that the author presents the most significant feature of the transition from Ptolemy to Copernicus in the following brief (and only) reference to the event " In the sixteenth century, Copernicus, a cleric and physician as well as astronomer, got out the system that is accepted to day thus was fulfilled the conjecture of St Thomas that some day another system might supplant the Ptolemaic " Apart from matters of prejudice, however, the reasoning is not of the kind which is likely to convince the scientific mind What, for example, are we to make of the following argument to prove that the assertion that the material universe is actually infinite in extent is contradictory in itself " ?—" In any *extension* we can conceive a part to be subtracted annihilated, or removed from consideration Now the remainder is either finite or infinite If finite, then that finite remainder plus the finite part removed equaled infinity, which is a contradiction If the remainder be infinite, then the void left by the part subtracted constitutes a limit to the infinite remainder, and by restoring the part we add to the actually infinite all of which is contradictory " We can only say that those to whom such arguments appeal will find here a systematically classified text book, each chapter of which contains a concisely worded thesis, arguments in favour thereof, a statement of possible objections with the replies thereto, and a list of references to other relevant literature The book is clearly written and well produced H D

Hurricanes in the West Indies

Los Huracanes en las Antillas Por Rev Simón Sarasola, S J Segunda edición, aumentada con el Apéndice Génesis y Evolución del Huracán de 20 de Octubre de 1926 y Catálogo de Ciclones en la Isla de Cuba de 1865 a 1926, por Rev Gutiérrez Lanza, S J Pp xv + 254 (Madrid Bruno del Amo, Habana 'La Moderna Poesía", 1928)

THE early appearance of a second edition of this useful treatise on the hurricanes of the West Indies by the Director of the Colombian Observatory at Bogota suggests that the work has already been found serviceable in that part of the globe

It appears that there is a suggestion of an English translation before long, which seems a highly desirable proposition in view of the number of British colonies in the West Indies Incidentally, such a translation would very considerably lighten the labours of an English reviewer who now asks the author's indulgence for any shortcomings resulting from unfamiliarity with Spanish

The treatise opens with a general account of the circulation of the atmosphere and the character of cyclones with a discussion of the different kinds of clouds illustrated by some good photographs, among which is a thundery cumulo nimbus of superb proportions It then goes on to the proper subject matter more specifically, dealing with the signs of approaching hurricanes, differences in their intensity and in the frequencies of the tracks they pursue in different months of the year It is shown how far European methods of forecasting storms based upon the principles of Bjerknes Guilbert Vercelli and others are locally applicable, and a considerable amount of space is given to the theory of tropical revolving storms The concluding part of the book discusses the correlation between hurricanes and sunspots and other indices of solar activity, but as usual in this field without any very decisive results

Tropical cyclones appear to make up for their greater violence by being distinctly less frequent than those of extra tropical latitudes, although a comparison is rendered difficult since there is no evidence of uniformity in the criteria adopted for defining a West Indies hurricane and a European gale A catalogue at the end of the volume shows that in the single island of Cuba, eighty five ' hurricanes ' of varying intensities occurred during the sixty two years, 1865–1926, giving an average of one or two a year whereas the number of ' general gales ' in the British Isles average about ten yearly

As in all other regions devastated by tropical storms, the West Indies suffer most in the later summer and autumn months Thus, out of 239 cyclones of varying intensities recorded in the West Indies between 1887 and 1923, May had 1, June 16, July 17, August 39, September 78, October 71, November 15, and December 7

The author presents a very impartial and open minded account of the vexed question of cyclonic genesis, and states his own views on the subject We should like to suggest that he might here have effected to advantage some unification of ideas Whereas he favours the view that the tropical disturbances arise from the encounter of opposing currents, he does not take kindly to Sir Napier Shaw's suggestion that polar front principles may be applicable in this region Now hurricanes in the West Indies, as in other tropical regions, occur

just at the time of year when the migrating trade wind system, having reached its farthest position across the equator is likely to be more heavily charged with moisture than the other trade system which it encounters Hence there is likely to be some kind of 'front' or 'discontinuity' in the trough of relatively low pressure between the interacting trades where the cyclones form and there is actual evidence that humidity 'fronts' in the doldrums may play a more important part in storm production than thermal fronts, which are so pronounced in temperate latitudes (See for example, C S Durst, *M O Geophys Mem*, No 28, 1926)

We think it should be better realised by writers on the theory of cyclones that there is nothing to warrant the assumption that these any more than other natural phenomena, are to be explained in terms of a single cause There must be various contributing collateral and sequential factors involved in the cause of cyclones

The appendix gives a vivid narrative of the dreadful cyclone that devastated Cuba in October 1926 The Meteorological Service issued timely warnings, and such measures as were practicable to lessen the number of fatalities were taken in the city of Habana and elsewhere It is quite clear that cyclones in the West Indies are taken very seriously, as well they might be A bad storm may take a day or two to pass over a district, may bring 10 to 20 or more inches of rain in twenty four hours, and wind blowing at the rate of 100 to 150 miles per hour There can be no question that when the area covered and time occupied by such violence of wind and rain are considered, the tropical cyclone must be regarded as the most formidable type of storm that occurs on this planet, with the possible exception of the great snow blizzards of colder climates

L C W B

Our Bookshelf

The Normal and Pathological Physiology of Bone its Problems By Prof R Leriche and Prof A Policard Authorised English Translation by Prof Sherwood Moore and Prof J Albert Key Pp 236 (London Henry Kimpton, 1928) 21s net

"LES problèmes de la physiologie normale et pathologique de l'os" of Leriche and Policard was published in Paris in 1926 The two American doctors to whom we are indebted for this translation plead difficulty in excuse of defects which are indeed evident There are, however, few obscurities which cannot be resolved without access to the original The French title is to be preferred to the English, because it modestly emphasises the 'problems' instead of the physiology The work is, happily, not physiological It is incorruptibly biological, and in this its remarkable character lies Areas in process of ossification are in reality regions with a sluggish circulation, with difficult interchange The composition of the blood in the great vessels permits no deduction concerning the chemical behaviour in these areas That is the weak point of all chemical research up to the present time The methods are most exact, but that is not true of the object subjected to research The problem on the whole is badly put And when well put, the methods are no longer applicable" Bone formation is a succession of phenomena hæmorrhage, de differentiation' of connective tissue, œdema, resorption of bone and its deposition in the ossifiable medium present Each of these phenomena is in itself commonplace What is peculiar is their juxtaposition The essence of the process lies in a vascular congestion acting simultaneously on the connective tissue and a calcified tissue" It is an organic result The work should be in the hands of every English surgeon, both on account of its extensive practical wisdom, and as an instruction in methods of research It is a little distressing to see the word evolution so carelessly used The original conveys a variety of meanings

The Economics of Rail Transport in Great Britain By C E R Sherrington Vol 1 *History and Development* Pp xii + 283 Vol 2 *Rates and Service* Pp xii + 332 (London Edward Arnold and Co 1928) 12s 6d net each vol

MR SHERRINGTON'S two volumes are complementary to each other, each containing the same foreword by Sir Guy Granet and the same preface, while the first volume after a short chapter on the function of transportation, deals with the growth of British railways, their rolling stock, locomotives tracks, and the regulations which are part of their history the second volume treats of the organisation and administration of railways, and their relation with the State the public, and industry His wide experience as a lecturer on economics and as secretary to the Railway Research Service enables him to write in an impartial yet authoritative manner, and no one interested in railways could fail to appreciate his masterly review The history of the British railways treats of them in the four groups as we see them to day, the review of the locomotive development is more general As to railway administration, the trend is towards a closer study of the internal economy of railway management, and from the second volume the layman can obtain some impression of the complicated nature of the problems involved

Regarding nationalisation, Mr Sherrington remarks that "it is hard to visualise in the case of the railways any very great advantage in the change over under present conditions, and it certainly would tend to decrease any desire to improve efficiency", while in his discussion on

road transport he says, 'where ruthless competition for traffic not sufficient to warrant the two systems is taking place, its development should be opposed provided the rail method satisfies public wants, and can be operated more cheaply"

Matriculation Botany a New School Course By Mary A Johnstone Pp xii + 324 (London and Toronto J M Dent and Sons, Ltd, New York E P Dutton and Co, 1928) 4s 6d

IN spite of the number of school text books of botany already available which cater for the needs of candidates of matriculation standard, teachers of such pupils would be well advised to consider Miss Johnstone's manual The author thinks that "to a large extent general knowledge of plant life is best acquired through the detailed study of the life histories of a few specially selected plants", ecology being treated as an integral part of plant study from the beginning Carrying out this idea, she uses the life histories of bluebell, lesser celandine, coltsfoot, and wheat as starting points for a thoroughly sound school course on the physiology, structure, classification, and adaptation to environment of common plants The section on soils and the notes on common trees are also worthy of special mention

The skilled teacher is in evidence throughout the book, and the scientific spirit is displayed in such comments as the following "Because these are advantages they must not be assumed to be the reasons" (why certain trees are deciduous)—an example of the kind of warning of which students of botany are in constant and peculiar need The 120 illustrations are excellent examples of the line drawings which pupils should be required to make—except in one respect the scale of magnification or reduction is consistently not stated It is, indeed, conceivable that unwary young readers might suppose, from an examination of the drawings of soil bacteria, that *Nitrosomonas* is not only of the general shape, but also of the size, of a tadpole! Another small fault, which should be rectified in the reprints which are sure to be called for, is the repeated reference to 'centimetres' of water on p 259

Dynamics a Text book for the use of the Higher Divisions in Schools and for First Year Students at the Universities By A S Ramsey Pp xii + 259 (Cambridge At the University Press, 1929) 10s 6d net

THIS book is intended primarily for students in the higher divisions of schools who intend to take an honours course of mathematics at a university, and also for university students preparing for a first honours examination The text is based upon courses of lectures given to first year students preparing for the Mathematical Tripos, and it is assumed that readers are already familiar with elementary dynamics, and have an intimate knowledge of the elements of the calculus

The subject is presented with logical precision, and in a manner which is admirably appropriate to the requirements of those students for whom the book is intended An excellent feature is the wide range of worked examples given in each chapter, and to these are added extensive series of exercises taken either from scholarship papers or from Tripos papers The contents of the chapters include kinematics, kinetics, dynamical problems in two dimensions, harmonic motion, motion under constraint, the law of reaction, impulsive motion, orbits, moments of inertia, energy and momentum, equations of motion miscellaneous problems, and small oscillations

Vorlesungen über Elektrizität Von Prof A Eichenwald Pp viii + 664 (Berlin Julius Springer, 1928) 36 gold marks

PROF EICHENWALD'S book has been carefully written and carefully printed, the list of corrections contains only one small item The text extends to 659 pages and contains 640 diagrams In Great Britain it would probably have been published in two or three volumes It is divided into three parts The first part includes the main principles on which the sciences of electricity and magnetism are founded The treatment is on the best academic lines, only the main mathematical theorems being given The second part discusses electrons both in liquids and gases, radioactivity, and electric and magnetic phenomena connected with electrons In the third part the theory of alternating currents is given, special stress being laid on oscillations and waves The practical theory of radio communication is also discussed In the final chapter the theory of Röntgen rays is given, and also the quantum theory Maxwell's theory is given fairly fully, and some of the theorems of relativity We notice that the gauss is used for the unit of magnetic force and the maxwell for the unit of magnetic flux With the notable exception of *J* instead of *I* for current, international symbols are used

The Preparation of Plantation Rubber By Sidney Morgan With a Preface and a Chapter on Vulcanisation by Dr Henry P Stevens Second edition Pp xvi + 357 (London Constable and Co, Ltd, 1928) 21s net

INFORMATION gathered at first hand is here given concerning the production and treatment of rubber, the main theme being its preparation for the market Mr Morgan, who has drawn fully upon his extensive researches on such processes as tapping, coagulation, rolling, drying, and smoking, deals with operations in the field and factory, and contributes other sections on machinery and buildings, finished rubber, and general matters, while Dr Stevens supplies the preface and an outline of the important subject of vulcanisation Among new matter included in the second edition, attention is directed in particular to bud grafting, cover plants, and manures The book is well produced, generously illustrated, and full of valuable practical information which cannot fail to be of service to all who are concerned with the growing, curing, packing, manufacture, or general handling of rubber and rubber goods

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Diffraction of Electrons by a Copper Crystal

INVESTIGATIONS of the secondary electron characteristics of a poly crystalline copper surface have shown that maxima and minima appear in the low voltage region of the total secondary electron curve only after the copper target has been heated at rather critical temperatures (*Phys. Rev.*, 25, 41, 1925). Accompanying the appearance of these maxima and minima, a change has been observed in the angular distribution of the secondary electrons (*Phys. Rev.*, 31, 414, 1928). These considerations, together with others (*Phys. Rev.*, 31, 419, 1928), make it appear that the changes in slope in the low voltage region of the characteristic secondary electron curve of a metal are a function of the orientation of the surface crystals, as are also the directions of the scattered electrons.

It thus appeared advisable to measure the total secondary emission from a single copper crystal under the same conditions as the angular distribution of scattered electrons. This has been done for bombarding potentials between 1 and 150 volts.

The apparatus is constructed of molybdenum to eliminate magnetic effects and the earth's field is compensated by Helmholtz coils. A special type of electron gun is used which produces a more intense beam of electrons than the usual type for the very low voltages (*J.O.S.A. and R.S.I.*, 15, 290, 1927). The electrons strike at normal incidence the (100) face of the copper crystal which is placed at the centre of a drum. One edge of the drum is made with a slot so that electrons may pass through and into the opening of the double Faraday box, which may be rotated from the plane of the target to within 13° of the incident beam. The target may also be rotated about an axis perpendicular to its face and may be removed into a side tube where it may be heated to red heat by bombardment. The moving parts are operated by magnetic controls which are sufficiently far removed to cause no measurable effect at the target. In taking observations on angular distribution the potential of the inside Faraday box is so adjusted that electrons which have lost more than 1 volt at the target are not permitted to enter.

The total secondary electron curve shows two maxima in the low voltage region at 3 volts and 10.5 volts respectively. Several marked changes in slope occur in the region between 10.5 volts and 150 volts. Intense electron beams are found to issue from the crystal at potentials for which the above maxima occur and at such potentials as to account for many of the changes in slope between 10.5 and 150 volts. Others may be accounted for by the diffraction beams which would be expected to leave the crystal in the direction of the normal but are outside of the solid angle of observation. It thus appears that the energy levels of the atom at most play only a comparatively small part in the production of sudden changes in slope in this region, since the electron diffraction beams apparently depend only on the positions of the atoms and not on their structure.

Now, a consideration of the wave length of the electron and the atomic spacing of a copper crystal shows that no electron beams due to diffraction are to be expected in the very low voltage region in the solid angle accessible to observation, since the plane grating formula $n\lambda = d \sin\theta$ must be satisfied, and the maximum possible wave length is obtained for $\sin\theta = 1$. Hence most of the beams in the low voltage region have no X-ray analogues. They do occupy, however, the approximate positions to be expected by a wave of one half the length given by the usual expression $\lambda = h/mv$, if a value greater than unity is taken for the refractive index.

Seven sets of electron beams are found to issue from the crystal in the two principal azimuths which are the X-ray analogues and require a refractive index greater than unity. In addition, 8 sets of beams are found in the (100) azimuth which may be accounted for by assuming a wave length for the electron which is one half that given by the formula $\lambda = h/mv$. One other weak set in this azimuth is unaccounted for by either of the above relations. In the (111) azimuth 3 sets are accounted for by the one half λ relation. There are 4 other sets in this azimuth, 3 of which may possibly be accounted for by a one third λ relation, while one weak set appears anomalous. In addition to the above the 3 volt beams do not appear accurately in either azimuth and are not reproducible.

Many of the beams are remarkably strong and sharp. In the case of a 70 volt beam the background scattering in azimuth is found under the best vacuum conditions to be only 4.3 per cent of the maximum intensity of the beam.

The sets of electron beams accounted for by the above relations, with one exception, require a refractive index greater than unity. However, the voltage differences between the electron beams and their X-ray analogues are found in general to increase with the voltage from about 6 or 7 volts for the lowest, to about 30 volts for the highest voltage in the range below 150 volts. The exceptional set, which is very weak, requires a refractive index of about unity with the association chosen.

The electron beams satisfying the $\lambda/2$ relation would also be accounted for by whole λ wave lengths and twice the atomic spacing for a copper crystal and might thus suggest a surface gas grating having twice the copper spacing. Such plane grating beams have been observed by Davisson and Germer (*Phys. Rev.*, 30, 705, 1927) from the (111) face of a nickel crystal. The beams observed from the copper crystal, however, appear not to be due to gas, for they are space grating beams and not surface grating beams. Further, they are observed under the best vacuum conditions, which must be of the order of 10^{-8} mm. mercury, and only a few minutes after the crystal has been heated at red heat, that is, while it is still considerably above room temperature. A temperature effect of these beams has been observed similar to that of the whole λ beams. The beams attain their maximum intensity about one half hour after heating. The copper crystal has been heated at red heat for several hours so that no pressure is observable on a sensitive McLeod gauge (a distance of 0.75 mm. in the top of the gauge capillary corresponds to 10^{-6} mm. mercury), while the crystal is at red heat.

If the possibility of an effect due to gas is ruled out, it appears necessary to conclude either that there are wave lengths associated with the electron in addition to that given by the formula $\lambda = h/mv$, or that the electron waves are scattered from alternate rows of the copper atoms with different intensities, both in the plane grating and the space grating. Because of the 4-fold symmetry in azimuth, the crystal appears to be single. Since the crystal was formed by the method of melting and slow cooling in an atmosphere

of hydrogen, the possibility of contamination by copper oxide should be eliminated The experiments will be continued with other crystals

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Some further Observations on *Amoeba proteus*

DR MURIEL ROBERTSON'S paper entitled 'Notes on certain points in the Cytology of *Trypanosoma raiae* and *Bodo caudatus* ' (*Paras* vol 19, No 4, Dec 1927) made me resolve to re investigate the nucleus of *A proteus* in the various stages of its life history by means of Feulgen's Reaction A full account of this chemical test for chromatin, as well as a Table of Procedure drawn up from her own experience, is given by Dr Robertson I had to modify this table in some respects *A proteus* is too heavy to remain adherent to the slide during all the drastic procedure involved in bringing about the reaction I therefore made use of the method used on previous occasions that is, of carrying on all the operations in a centrifuge As it was not practicable to wash the amoebæ in running water the liquid in the centrifuge tube was replaced by water and this was changed five times, at 15 minute intervals

Dr Robertson placed no ban on acid containing fixatives I therefore began my experiments by using Bouin's modified formula (Duboscq Brasil 1905) The formalin in it helped to harden the cytoplasm It was found necessary in the case of *A proteus* to treble the time allowed by Dr Robertson That this need was due to the nature of the *A proteus* nucleus rather than to the modifications in method described above, was proved by control experiments in which flagellates and ciliates were found to be brightly coloured after normal exposure to the stain

The interesting new fact that emerges from this study is that the *whole* of the karyosome of the *A proteus* nucleus gives the reaction for chromatin just as positively as does the macro nucleus of a ciliate Amid the general substance of the karyosome irregular patches are more deeply stained and the chromatin 'blocks' in the periphery are also a deep red The achromatic structures show up in marked contrast, especially when light green is used as a counterstain None of the cytoplasmic structures are affected by the Feulgen with or without hydrolysis

Consequent on the failure to obtain positive results for the karyosome of the nucleus of young immature *A proteus* even after prolonged staining non acid corrosive alcohol and absolute alcohol were tried as fixatives, lest the failure should be due to the Bouin's fluid previously used The results were the same the karyosome again failed to give the reaction The 'blocks', which are extremely small were faintly red, and there was a diffuse red stain surrounding the blocks in the periphery The nucleus of the young *A proteus* would appear to contain very little chromatin, a conclusion borne out by its great affinity for plasma stains

The colour produced by fuchsin after fixation in a non acid fixative is much more pink and less purple

This study has necessitated a renewed and detailed scrutiny of many cultures of *A proteus*, and in view of the fact that a flagellate stage, followed by syngamy, has recently been described as occurring in the life cycle of *A proteus*, I should like to record, once more, that in spite of years of study I have failed to find any such stages The life cycle, in fact, would appear to be wholly asexual

Amoeba bigemma **bears a superficial resemblance to young stages of *A proteus* It can easily be cultivated** under the same conditions as *A proteus* *Amoeba verrucosa* similarly grows readily under these same conditions, and when it is young is extremely active in movement Stained preparations of each of these could easily be mistaken for young *A proteus* from their nuclear characters, unless the cytoplasmic characters of each had been observed before fixation of the specimen So far as I am aware, the life cycle of neither of these species has been worked out, and therefore the existence in them of a flagellate stage is not excluded, although in my opinion unlikely

Cultures of *A proteus* are liable to be attacked and even killed off by a flagellate parasite and it is conceivable that this has been interpreted as a phase in the normal life cycle of the amoeba

It is of interest to note that in 1918–19 a strain of *A proteus* was observed to contain symbiotic green flagellates The culture was unfortunately exhausted for supplying class and demonstration material I have never had time to investigate the matter nor to make any experiments in bringing about the conditions which induced the symbiosis The symbiont has a nucleus typically flagellate, of about 60 μ and its own diameter in stained preparations is from 150 μ to 180 μ Some of these preparations contain four symbionts in a single amoeba

Although *Euglena nematoides* is a frequent inhabitant of *A proteus* cultures the amoeba do not seem to be able to prey upon it as they do on other flagellates at least in its active stage Although I have often watched a conflict between the two I have always found that the *Euglena* makes its escape

MONICA TAYLOR

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May 25

Negrito Racial Strain in India

IN a short note in NATURE of May 19, 1928 (vol 121, p 793) I mentioned the discovery of a truly negrito strain among the Kadars in the extreme interior of the Cochin Hills (S India) As a result of further investigations in the adjoining hills made this year I was able to find 10 more individuals showing spirally curved hair making a total of 16 (a little more than 10 per cent) out of 157 men and women measured Of the 10 individuals found this year, 8 were Kadars, and the remaining two were a Pulayan and a Malser The hair of all of those except two, who have very short spirals (Fig 1*a*), are of frizzly type similar to that of the Melanesians (Fig 1*b*), matching No '*q*' in Martin's scheme ('Lehrbuch ", 2nd edition, vol 1, p 213) The hair of the two with short spirals would resemble '*h*' rather than '*i*' in the same scheme In appearance they are without exception very dark, the skin colour varying from 29 to 34 in Von Luschan's scale, short, prognathic, having thick everted lips, short broad nose flattened at the root with the tip tilted up The average cephalic and nasal indices of the 10 are 75 23 and 85 6 respectively, bringing them just within mesocephaly and platyrhiny

The presence of the Melanesian form of hair is interesting, because it definitely links up the aboriginal people of S India with Melanesia , but of the short woolly haired type I am not so certain I am inclined to regard it as distinct from the frizzly haired type unless the latter may be considered the result of hybridisation with the wavy to curly haired type which forms the dominant element among the Kadars at present Whatever may be the ultimate explanation of this, there is no doubt that among the aborigines of S. India there still persists in the extreme interiors a primitive element of a genuine negrito

character, as shown by its occurrence not merely among the Kadars but also among the Pulayans and the Malsers It is not impossible that such a type exists among other aboriginal tribes of Southern and Central India in regions which have not so far been carefully explored Dr J H Hutton's discovery ("Man in

a *b*

FIG 1 —Kadars of the Cochin Hills with woolly and frizzly hair respectively

India", vol 7, No 4, pp 257 262) of spirally curved hair among a section of the Angami Nagas would extend it to the eastern frontiers and lend support to the view of the wide distribution of the negrito type at one time in India

The results of my investigations on the Kadars of the Cochin and Anamalai Hills will be published as soon as the details are worked out

B S GUHA

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Penetrating Radiation and de Broglie Waves

BOTHE and Kolhorster have recently published a preliminary account of an experiment on the absorption coefficient of the penetrating radiation (NATURE April 27, p 638) They conclude that this radiation is of corpuscular rather than of gamma type The purpose of this note is to show that their experiment may be inconclusive

The de Broglie wave length (de Broglie, "Ondes et Mouvements" 1926, p 10) for an electron moving with velocity v is

$$\lambda_B = \frac{h\sqrt{1-\beta^2}}{m_0 v}$$

If this electron were suddenly stopped, the wave length of the emitted quantum would be, on the basis of Einstein's photoelectric equation

$$\lambda_E = \frac{h}{m_0 c}\,\frac{\sqrt{1-\beta^2}}{1-\sqrt{1-\beta^2}}$$

The ratio
$$\frac{\lambda_E}{\lambda_B} = \frac{\beta}{1-\sqrt{1-\beta^2}}$$

approaches unity for wave lengths of the order of magnitude of those under discussion For example Millikan and Cameron (*Phys Rev* [2], **31**, 921, 1928) give 0 00008 A for the wave length of their most penetrating radiation If one takes $\beta = 0\ 99999$, then $\lambda_E = 0\ 000109$ A and $\lambda_E/\lambda_B = 1\ 0045$

The results of experiments (Davisson and Germer *Phys Rev* [2], **30**, 705, 1927, Kikuchi *Proc Imp Acad Tokyo*, **4**, 471, 1928) have shown that the de Broglie wave length of low velocity electrons can be used to explain their reflection from and diffraction in crystals It is suggested by analogy that, in the scattering of high velocity electrons and high frequency electromagnetic radiations of the same energy, the distribution in angle and the energy relations between the incident and scattered rays may be nearly identical

If one assumes the mass of an electron and the mass of a quantum to be respectively

$$m_e = \frac{m_0}{\sqrt{1-\beta^2}} \qquad m_q = \frac{h\nu}{c^2},$$

and uses the above expression for λ_E, it is seen that

$$\frac{m_e}{m_q} = \frac{1}{1-\sqrt{1-\beta^2}}$$

For the velocity considered above $\frac{m_e}{m_q} = 1\ 0045$

From this one may derive further grounds for extending by analogy, the already established duality to the present case In the scattering formula of Klein and Nishina (*Zeits f Physik* **52**, 853 1929), ν occurs only in the factor $h\nu/m_0c^2$ Therefore if one substitute m for $h\nu/c^2$ the numerical result is changed only slightly for large values of β

If the above hypothesis should be valid, the analysis of penetrating radiations at the surface of the earth into electrons or light quanta might be impossible by means of simple scattering or absorption experiments

It is also possible that some of the rays from radioactive substances recently classified as short wave gamma rays may in reality be high speed beta rays

E I HOLMES

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Magnetic Properties of Isolated Atoms of Cobalt

FERRO MAGNETISM is one of the most complicated and least explained subjects This is because in most of the experimental work what are observed are statistical phenomena from which it is difficult to arrive at a knowledge of the elementary mechanism It was therefore thought interesting to investigate alloys of a small percentage of cobalt with platinum namely, 10 per cent Co – 90 per cent Pt and 5 per cent Co – 95 per cent Pt in which the ferro magnetic cobalt atoms are not generally surrounded by other magnetic atoms but by non ferro magnetic platinum atoms

These alloys were found ferro magnetic, the Curie point being 249° C and 49 C for the 10 per cent and 5 per cent alloys respectively The magnetisation, I, at different temperatures from that of liquid air up to the Curie point was found for each alloy, the decrease in magnetisation near the Curie point being most rapid for the 5 per cent alloy For small values of the applied magnetic force (H – 0 to 100 gauss) I increased at first with temperature, but for greater values of H it decreased steadily The greatest values of I obtained ($H = 565$ gauss) were 364 and 254 C G S units for the 10 per cent and 5 per cent alloys respectively This corresponds to a magnetic moment per cobalt atom 25 per cent and 60 per cent greater than that calculated from the saturation magnetisation of pure cobalt, assuming the platinum atoms do not contribute to the magnetisation

Finally, various hysteresis loops showing the relation between I and H were obtained These were found to vary considerably with the heat treatment For wires in the hard drawn state, the 5 per cent alloy gave the larger and more rectangular loops, with a coercive force as great as 100 gauss but after annealing at different temperatures, the hysteresis was greatly reduced, the 5 per cent alloy showing a coercive force of only 20 gauss as against 28 for the 10 per cent alloy This last result, for the annealed wires, is in accord with Heisenberg's theory of ferro magnetism based on the resonance between the

spinning electrons of neighbouring atoms (*Zeit f Phys*, **49**, 619, 1928), on this theory one would expect less hysteresis as the magnetic atoms become more isolated The theory also explains the effect of annealing in reducing the hysteresis by uniformly distributing cobalt atoms which were closely clustered in groups in the hard drawn state, and thus likewise reducing resonance phenomena

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The Atomic Weight of Arsenic

As the International Committee on Atomic Weights has not provided a table since 1921, the British Sub Committee published in the *Journal of the Chemical Society* of January last a revised table of atomic weights for 1929 In the report attached to this table we read that "for the nine 'simple' elements H, He, C, N, F, Na, P, As, and I the values obtained by F W Aston with his new mass spectrograph are adopted in preference to those deduced from the physical or chemical data, because we are of opinion that, in these cases, Aston's method is less liable to error than any other"

Dr Aston is to be congratulated that his spectro graph allows the reading corresponding, as regards the accuracy, to that of modern atomic weights deter mination, namely, 1 in 10,000

Since from the year 1927 I have been engaged on the revision of atomic weight of arsenic, based on chemical analysis, I am highly interested in the new Aston figure, As = 74 934, derived for this element from the mass spectrum alone The atomic weight of arsenic, As = 74 96, hitherto adopted internationally, is based on the Baxter and Coffin method of converting silver arsenate into silver chloride or silver bromide by the action of hydrogen chloride or hydrogen bromide From the chemical point of view this international value for arsenic is a little higher than the actual one From this reason I have undertaken a new determination of this figure deduced from the analysis of the purest arsenic chloride and bromide From the eight determinations of the ratio $AsCl_3$ 3Ag hitherto made, I have obtained the average As = 74 937 (using Ag = 107 88 and Cl = 35 458), which is in ex cellent agreement with the value obtained by Aston This agreement corroborates the probability of the lower value, which was to be expected, and shows at the same time the trustworthiness of Aston's method used for the derivation of atomic weights of simple elements

My preliminary paper concerning this matter was read before the Congress of Czechoslovak Scientists held in Prague, May 1928 After completion of the analyses of arsenic chloride and those of arsenic bromide, the definite value obtained will be published

H KŘEPELKA
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Prague, May 7

A New Ultra-violet Band Spectrum of Hydrogen Chloride

HITHERTO no band spectra have been found which involve electronic excitation in neutral or ionised hydrogen chloride We have recently photographed an extended band system in the region λ2830 λ3966 from a low pressure discharge in pure hydrogen chloride gas with platinum electrodes The bands are degraded toward long wave lengths, and have the characteristic widely spaced structure always observed in hydride spectra A discharge in hydrogen gives the same band system if a small amount of silver chloride or cuprous chloride is fused on the electrodes, but not if silver bromide is used Thus there is strong evidence that this spectrum is due to the hydrogen chloride molecule Moreover, there are reasons, both experimental and theoretical, for believing that the emitter is singly charged, probably the HCl^+ ion For example, the bands are obtained only from the negative glow, whereas in general the spectra of ionised molecules, such as N^+_2, are relatively stronger

Owing to the unusual intensity distribution in this band spectrum, it has not been possible to reach an assignment of vibrational quantum numbers, and thus to determine the electronic frequency The isotope effect, which we hope to obtain by the detailed analysis of the fine structure now in progress, should prove helpful in this regard The bands occur in pairs of constant separation, 658 cm^{-1}, indicating that a doublet electronic level is involved The two components of a pair have about equal intensities The wave numbers of the band heads may be repre sented by

$$\nu = \left.\begin{matrix} 28446 \\ 27788 \end{matrix}\right\} + 1561p - 30\,3p^2 - 2573n,$$

observed values of (p, n) being $(-1, 0)$?, $(0, 1)$ $(3, 1)$?, $(0, 0)$, $(1, 0)$, $(2, 0)$, $(3, 0)$, $(4, 0)$, $(5, 0)$ The pair $(0, 0)$ at λλ3514, 3598 is the strongest, and the five succeeding pairs have regularly decreasing intensity They apparently form a progression with a common vibrational quantum number in the lower state As was pointed out to us by Dr F Hund, it can be shown by a correlation with the energy terms of the equiva lent atom, Cl, and the separate atoms H and Cl^+, that a transition $^2\Sigma \dashrightarrow {}^2\Pi$ might be expected in HCl^+ A preliminary examination of the rotational structure shows that it is probably compatible with such an interpretation

BROOKS A BRICE
F A JENKINS
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Dirac Equations and Einstein Theory

HERMANN WEYL (*Proc Nat Acad of the U S A*, **15**, 323 April 1929) has recently developed a relativ istic theory of the Dirac equation which, like that of Wigner (*Zeit f Phys*, **53**, 592, 1929), and that of Vallarta and myself (NATURE, Mar 2, 1929, p 317), employs the Einstein notion of an '*n* leg' Unlike the two other theories, Weyl rejects Einstein's dis tant parallelism, and obtains a theory invariant under a local rotation varying continuously from point to point That is, Weyl's theory depends solely on the $g_{\lambda\mu}$'s of Einstein's 1916 gravitational theory, and not on the ${}_s h^\lambda$ of his 1929 theory It is perhaps interest ing to remark that the same degree of invariance may be obtained by choosing as the 4 legs of the Einstein theory the Ricci principal directions If we write $R_{\lambda\mu}$ for the 1916 contracted curvature tensor, this addi tional condition is expressed by the formula

$${}_t h^\mu {}_s h^\lambda R_{\lambda\mu} = 0 \quad (s \neq t) \qquad (1)$$

This condition is trivial and nugatory in case the original Einstein equations $R_{\lambda\mu} = \text{const}\ g_{\lambda\mu}$ are ful filled Since the new gravitational electric matter equations, whatever their final form may be, are close approximations to these, it is perhaps not too much to hope that the supplementary condition (1) not only is compatible with them, but even not too restrictive so far as terms of observable magnitude are concerned

Thus gravitational phenomena appear to be such

as can occur even in a homogeneous Riemann space, whereas matter electrical phenomena depend on the inhomogeneity of space This may well have some thing to do with the absence of spherical symmetry in the spin inseparable from the electron

So far as the quantities ${}^{i}h$ are concerned, the new auxiliary condition is of the second order The new Einstein field equations will probably not be of the second order when written in terms of the $g_{\lambda\mu}$'s, but it is not clear that the Weyl equations will escape this criticism The supplementary condition (1) leaves untouched the work of Wigner, Vallarta and myself Thus the Dirac equations may be treated relativistic ally on the basis of the Einstein 1916 theory

NORBERT WIENER
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Diamagnetism and Crystal Structure

PROF EHRENFEST has suggested (*Physica*, vol 5, p 388, 1925) that the high diamagnetic susceptibility of bismuth is to be ascribed to the existence in the metallic crystal lattice of electron orbits of large area including several atoms within their radius There seems good reason to extend Ehrenfest's hypothesis to the case of carbon as well, since it affords an illu minating insight into the magnetic behaviour of the different forms of this element It is known that graphite possesses a high specific susceptibility, which according to the most recent measurements of Vaidyanathan with carefully purified samples, is $-5\ 1 \times 10^{-6}$, that is, quite ten times larger than the specific susceptibility of diamond ($-0\ 49 \times 10^{-6}$), the latter being practically the same as that of carbon in organic compounds as found from Pascal's additive law The abnormal susceptibility of graphite be comes intelligible in terms of the peculiar structure of the substance and its electrical conductivity, if we assume that there are electron orbits circulating round the plane hexagonal rings of carbon in the crystal lattice This fits in with the known fact (observed by Honda and Owen) that the susceptibility of graphite is six or seven times greater normal to the planes of cleavage than parallel to them Diamond, on the other hand, being a dielectric would naturally not show the abnormal susceptibility

Careful studies made by Mr P Krishnamurthi of the X ray pattern of sugar charcoal and lamp black prove conclusively that these substances do not possess any crystalline structure The fact that amorphous carbon has the normal susceptibility ($0{\cdot}51 \times 10^{-6}$), and not the high value of graphite, is therefore quite to be expected The great diminution in the susceptibility of bismuth which occurs on fusion may be regarded as an analogous phenomenon

Ehrenfest's hypothesis would appear to have also other fruitful applications, for example, in the ex planation of the remarkable diminution in the sus ceptibility of graphite at high temperatures and of the dependence of susceptibility on particle size in colloidal substances We need not, however, enter into those details here

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Salt Haze

I HAVE at intervals during the last few years directed attention to the presence of salt particles in the air and their importance in facilitating the formation of fog, since in the presence of a haze of sea salt con densation would commence upon the particles long before saturation is reached.

On May 27 last I was fortunate enough to observe a salt haze in process of generation I was on the north bank of the Tagus at about 8 A M , summer time It was a bright sunny morning, with a light wind from the north west, and looking across the river I observed a long stretch of sandy shore extending southward from the mouth of the Tagus I had a good view along this stretch of shore, and noticed that a well marked haze commenced along the line of the breakers and was carried seaward by the wind, extending gradually so that it partly obscured the hills in the distance There was a clearly defined line over the breakers where the haze commenced, and it was obviously formed from the spray On looking in the opposite direction over the land visibility was good, and practically no haze was to be seen

Later in the day, that is about 11 A M , in passing up the coast northward from the Tagus I saw another example of the same thing

In a small bight or bay of the coast there was a large number of rocks projecting from the water, and these caused a good deal of disturbance and spray due to the waves , from the surface of this bay a drift of haze was quite visible passing inland The sun was shining brightly at the time, and in this case as well as in the first mentioned, the haze was white In the latter case, doubtless the fine salt particles were carried inland to a considerable distance It is possible that few of them survive the cool, still night, when the air becomes cooled and condensation on the particles must tend to bring them down

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Rise and Fall of the Tides

IN NATURE of April 27, Mr A Mallock writes on rise and fall of the tides, and illustrates his views by three specific cases in which a constant amount of energy is continually concentrated into a diminishing mass To quote briefly A heavy flexible cord passes through a hole in a fixed horizontal plate The part below the plate is given an initial oscillation and swings as a pendulum The cord is then drawn upward through the hole The part above the plate is stationary, and the energy it contained is trans ferred to the part still hanging free, the mass of which continually decreases Hence the velocity of oscilla tion tends to become infinite when the length vanishes

Surely in this case it has been overlooked that as the cord is pulled up work is being done against the centrifugal acceleration, so that the kinetic energy of the moving portion is not constant, but is con tinually increasing ?

The case is analogous to that of a conical pendulum formed by a bob at the end of a string , if the string be shortened by any means the kinetic energy of the system is increased The same principle occurs in two common forms of human activity , the child swinging rhythmically raises his centre of gravity while his angular velocity is great and lowers it while it is small , the skater, moving over the ice by what is known as the Dutch roll, progresses by a series of alternating curves, never lifting his skates from the ice He rhythmically raises his centre of gravity while going round the curve (*i e* shortens the conical pendulum), and lowers it while reversing the curvature of his path By this means he steadily puts energy into the moving system, without its being obvious to the non skater how he is doing it

L H G DINES
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The Late Palæozoic Glaciation

By Dr H DIGHTON THOMAS

THE great continent of Gondwanaland existed in the late Palæozoic in the southern hemisphere and persisted through a long period of geological time with little modification The deposits formed on it are found in Australia, India, South Africa, South America, and Antarctica, where beds of glacial origin generally occur at the base of the series The fossilised remains of the flora which flourished on the continent in its early stages are found sometimes in, and generally above, the glacial horizon Characteristic plants are species of *Gangamopteris* and *Glossopteris* The whole floral assemblage is very different from that yielded by the Upper Carboniferous and Permian continental deposits of the northern hemisphere, in which the Pteridosperms (*e g Alethopteris*), Lycopodiales (*e g Lepidodendron*), Equisetales (*e g Calamites*), and Cordaitales (*e g Cordaites*) predominate

Intimately linked with the problems of Gondwanaland are the questions of the age of the late Palæozoic glaciation and of the age and range of the *Glossopteris* flora Was the glaciation in Carboniferous [1] or in Permian time? Did the first members of that flora exist contemporaneously with the latest Carboniferous flora of the northern hemisphere, or did they make their appearance later, in the Permian? For long, different opinions have been held, though in general those of British geologists have tended more and more definitely towards a belief in a Uralian age (Upper Carboniferous), both for the glacial period and for the entry of the *Glossopteris* flora Prof C Schuchert has recently attempted to answer the question decisively (*Bull Geol Soc America*, vol 39, No 3, 1928, pp 769 886), and in doing so has performed an invaluable service in bringing together in an accessible and summarised form a mass of stratigraphical and palæontological details In his long paper Schuchert deals with the evidence furnished by most of the important localities in the southern hemisphere and in India To these he adds résumés of the important Russian, German, and North American horizons which bear on the problem to be solved His conclusions briefly are that the glaciation occurred "in Middle and probably in Late Middle Permian time", and that the *Glossopteris* flora does not range back beyond that period In these conclusions Schuchert states that he has the support of Dr David White, the noted American palæobotanist

Fundamentally, in making his correlations Schuchert uses as a standard the succession in the Salt Range, so that the determination of the age of the latter is of prime importance The whole of the Productus Limestone and of the underlying beds down to the Talchir Boulder Bed he assigns to the Permian, firstly, on the evidence of Upper Permian ammonites (*Xenaspis* and *Cyclolobus*) in the Virgal and Chideru groups, and secondly, because of "how intimately the whole of the Productus Limestone is tied together faunally" The latter statement rather overstates the case The number of species, particularly of the Brachiopoda, that range through the Productus Limestone Series is small, and it is highly dangerous to use such long ranged forms in correlation The ammonites give the age for the containing beds, but are no proof of the age of those below them They first occur in the Salt Range in the zone of *Xenaspis carbonaria*, the whole of the succession of about 800 feet below that horizon down to the glacial bed being devoid of such forms The age of these beds can be deduced only from a consideration of their faunas, and particularly from the Brachiopoda, because of the knowledge we possess of their range in time

From this point of view the first important fossiliferous horizon above the Talchir Boulder Bed is the Amb group of Noetling, approximately equal to the Lower Productus Limestone of Waagen, this Schuchert refers to the Basal Upper Permian The faunal evidence will scarcely support this opinion From this horizon Waagen described a large fauna which has to some extent been emended by Noetling and Koken The faunal lists given by the latter, and by Waagen, show a large number of forms which occur also in the Urals and in Timan In that classic and standard area for the Upper Carboniferous most of the forms common to the Russian area and to the Amb Series do not range above the Artinskian (Lower Permian), and the majority of them not above the *Schwagerina* zone (Upper Carboniferous) As examples, *Dielasma itaitubense*, *Hemiptychina sublævis*, *Derbya regularis*, *D grandis*, *Rhipidomella pecosi*, and *Spirifer ravanah* may be cited Schuchert himself draws attention to the fact that "The Amb stage is characterised below by *Spirifer marcoui*", a species which he is careful to state does not range higher than the *Cora* zone (Uralian) in the Urals Even without considering the absence of such forms as the curious Brachiopod *Lyttonia* from the Amb fauna (which may not be an essential point in the argument) it becomes impossible to maintain for the Amb stage an age younger than Lower Permian At the latest a low horizon in the Artinskian is indicated Such being the case the underlying Speckled Sandstone, including the *Eurydesma* and *Conularia* zones—important for the correlation of the Australian and South African successions—and the Talchir Boulder Bed are of high Carboniferous (Uralian) age

Some confirmation is given by the recently described fauna from the Umaria coalfield of Central India Above a slight unconformity on the Talchir Boulder Bed occur thin marine, fossiliferous bands which are stated to pass up into the Barakar Series of continental origin The fauna is not a rich one, but its importance from its position above the

[1] The boundary between the Carboniferous and the Permian is here taken at the top of the *Schwagerina* zone and not, as drawn by Schuchert, at its base.

glacial horizon is obvious Cowper Reed placed its age as Permo Carboniferous and directed attention to its affinities with an Upper Carboniferous fauna It is doubtful if he implied by the use of the term 'Permo-Carboniferous' a definite Lower Permian age as Schuchert takes it to mean, it is more probable that he meant that the fauna might be either Upper Carboniferous or Permian in age, but that it is difficult to determine which from the evidence Even accepting a Lower Permian age for the fauna, it is difficult to see why Schuchert should reject such a determination, and state that the Talchir stage is Middle Permian, largely because the Barakar stage is stated to be Middle Permian The marine evidence is far more trustworthy than a correlation made through the fact that the beds pass up into the Barakar Series Ultimately the latter has to be correlated with marine successions, since our standards are founded on them From the evidence of the marine beds in the Umaria coal field a Carboniferous age for the Talchir stage is not improbable In the Indian Peninsula the latter stage, as well as the succeeding Karharbari stage, yields *Gangamopteris* and *Glossopteris*, so that there is strong indication that the establishment of the *Glossopteris* flora occurred at least in Lower Permian time, if not actually in the Carboniferous The occurrence of *Gangamopteris* in Kashmir in no way invalidates this The beds yielding them lie below the Permian Zewan beds, but the plant bearing horizons occur at a distance of 400 feet at least below the base of the Zewan series

The *Eurydesma* and *Conularia* faunas of the Salt Range are repeated in New South Wales and in South-West Africa, in both cases above glacial beds If these faunas are reliable guides they indicate an Upper Carboniferous age for the Lower Marine Series of the Hunter River in New South Wales, and for the Upper Dwyka Shales of South-West Africa Such an age has been accepted by Dr Du Toit and Prof Gregory among others The latter has directed attention elsewhere to the Carboniferous, as opposed to the Permian, aspect of the fauna of the Lower Marine Series of the Hunter River succession Thus not only are the glacial beds at the base of that series proved to be of Upper Carboniferous age (an opinion shared with Prof Sir T W Edgeworth David), but also the *Glossopteris* flora to have appeared in the Australian area at a similar time—leaves of *Gangamopteris* occur in places in some of the beds which comprise the Lower Marine Series An easy correlation can be effected between the Seaham Harbour Glacial Beds of New South Wales and the Bacchus Marsh Beds of Victoria, the Glacial Boulder Beds of Tasmania, etc The Greta Coal Measures, with abundant *Gangamopteris*, most probably represent the top of the Carboniferous development in New South Wales, the Upper Marine Series still faunally close to the Carboniferous probably marking the beginning of the Permian

On the Irwin River in Western Australia glacial beds are known to occur below marine horizons which are themselves overlain by Coal Measures If these latter are correctly correlated with the Greta Coal Measures of Eastern Australia, then the glacial beds which occur far below them in the sequence are also of Upper Carboniferous age Of the fauna of the marine beds in the Irwin River area the most important member, in some ways, is *Paralegoceras jacksoni*, the only Cephalopod so far recorded from there Its affinities (and by the kindness of Sir Edgeworth David the writer has had the opportunity to examine several specimens) are with Upper Carboniferous forms, and as far as one may rely on this species it supports an Upper Carboniferous age for the bed which yields it in large numbers and for the glacial beds below The rest of the fauna shows some anomalies, as Sir Edgeworth David has indicated It is unfortunate that Schuchert does not consider this glacial occurrence

Before leaving the question of the Australian beds, attention might be directed to the alleged presence of the ammonoid, *Agathiceras*, in New South Wales and in W Australia As importance is often attached to this in making correlations (and Schuchert himself mentions the occurrence), it is not beyond the point to state that some time ago Dr Spath and I examined the specimens in the British Museum (Natural History) sent over as that species They could all equally well be Bellerophontids A few months ago I received a letter from Dr F W Whitehouse, of Queensland University, stating that he had published a note in Australia some three years or so ago to the effect that the so called *Agathiceras micromphalum* is a Bellerophontid

Reference has already been made to some evidence for an Upper Carboniferous age for the Dwyka Conglomerate of South Africa The occurrence of the fish *Palæoniscus*, and of the crustacea *Anthrapalæmon* and *Pygocephalus*, in the Upper Dwyka Shales does not invalidate this, as Dr Du Toit has pointed out Dr A W Rogers has expressed a similar view Of great interest is the discovery of remains of the *Glossopteris* flora *beneath* the tillite at Strydenburg and at Vereeniging Prof Seward and Mr T N Leslie described the flora from the latter place—the *Glossopteris* and *Gangamopteris* leaves were associated with genera common in beds in the northern hemisphere, *Lepidodendron*, *Cordaites*, *Sigillaria*, and *Psygmophyllum* These hardly demonstrate an horizon as high as Middle Permian, to which Schuchert assigns the Dwyka Tillite The flora and the invertebrates together indicate an Upper Carboniferous age not only for the glaciation but also for the first members of the *Glossopteris* flora, an interpretation accepted by Prof Seward Du Toit has well said of another occurrence, "It might be remarked at the outset that the majority of the members of the *Glossopteris* flora are of *little or no value* in establishing the *absolute age* of the beds Recent work has been showing more and more that certain genera and species thereof had a long range in time " The Ecca beds (2000-6000 ft thick), which succeed the Dwyka Series, are, in Schuchert's view, of *Basal* Upper Permian age It is an amazing, though not necessarily incredible, development for such a small period of time

By means of the Upper Dwyka Shales, and more particularly from the "White Band", which yields the marine reptile *Mesosaurus tenuidens*, we can date the glacial deposits of South America It is generally admitted that that band and the Iraty Black Shales of the Paraná Basin are contemporaneous, so that, granted that the "White Band" is Upper Carboniferous in age, the Iraty Black Shales, which yield species of *Mesosaurus*, are also of that age But beneath them occur the Rio Bonito Coal Measures, with a typical lower Gondwana flora, including *Gangamopteris obovata* and *Glossopteris* spp, while lower down still are the Itarare Beds with a basal glacial horizon Du Toit has also adduced evidence for a Carboniferous age for the glaciations in the San Juan area of Argentina, in which region he believes that the *Glossopteris* flora, if not actually occurring with elements of the Northern Carboniferous flora, occurs in beds which are only slightly later than those yielding *Cardiopteris*, *Rhacopteris*, etc This glaciation and that of Barreal, where a glacial tillite is overlain by beds with a marine fauna shown by Cowper Reed to be of early Uralian age, receive scant reference by Schuchert

Prof Schuchert has performed an arduous task in compiling his lengthy work, and he deserves the thanks of all those who are interested in the problem with which he attempts to grapple We may differ from him, and contend that the evidence he adduces is more in accord with a Uralian age for the late Palæozoic glaciation and for the first appearance of the members of the *Glossopteris* flora But at least his arguments will stimulate renewed interest and thought on one of the big problems of the stratigrapher and of the palæobotanist

The Hormones of the Sexual Glands[1]

THE influence of the ovaries on other tissues is an established fact, less is known of the effect of other glands upon the ovaries, but evidence is accumulating that the maturity and periodicity of function of the female sexual glands depend on influences from other tissues or glands of the body Grafting experiments have shown that an ovary from an immature animal inserted into the tissues of an ovariectomised adult reaches maturity sooner than it would have done in its original environment a mature organ grafted into an immature produces no observable effects and becomes functionless A Lipschütz has obtained similar results when an ovary is grafted into a castrated male if the animal —guinea pigs were used—is an adult, hormonic effects, as shown by hypertrophy of the mammary glands, set in after 1½ 3 weeks, but if the animal en grafted is not fully grown there is a latent period of about six weeks ovaries from the same female may show these different latencies if grafted into males of different ages (*Jour Biol et Med Exper*, No 6, p 1, 1926) The grafted ovaries, however, do not usually show their normal periodicity, but enter into a state resembling prolonged œstrus

Y Tamura, working with mice, has, however, found evidence in some cases of the development of corpora lutea in grafted ovaries, the appearance of which suggested that they had been developed some time after the operation (*Proc Roy Soc Edin*, vol 47, p 148, 1927) He also found that the presence of the testis did not affect the vitality of the ovarian graft That ovarian regulation is at any rate partly somatic is further shown by the fact that removal of one gland leads to hypertrophy of the other, showing that some bodily factor limits the number of follicles which can come to maturity at any one time In this connexion it may be mentioned that T Tadokoro, M Abe, and S Watanabe have found differences between the proteins of certain tissues in male and female animals of various species (*Jour Facult Agricult*, *Hokkaido Imp. Univ*, vol 23, p 1, 1928)

[1] Continued from p. 915.

Recent work indicates that the anterior lobe of the pituitary and also the thyroid glands exert a definite influence on the ovary It has long been known that the former influences both bodily and sexual growth, and also that it hypertrophies during pregnancy, recent evidence suggests that at least two, if not three, different principles may be secreted by this gland, a growth promoting, one hastening ovulation and sexual maturity, and one inhibiting ovulation by stimulating the development of lutein tissue Precocious maturity in rats and mice can be provoked by injection of macerated aqueous suspensions of fresh anterior lobes, œstrus setting in after about three days acid extracts produce this effect in concentrations which have no effect on growth in an adult

The same hormone occurs in human placenta and the urinary secretion of pregnant women experiments on filterability and adsorption indicate that it possesses a smaller molecule than the growth promoting principle On the other hand, alkaline extracts of less fresh glands produce growth together with luteinisation of the ovary the follicles develop into corpora lutea without ovulation, and with enclosure of the ova, further ovulation is prevented This luteal tissue sensitises the uterus to stimuli, produces mammary overgrowth, and, developed during pregnancy, results in prolongation of this condition There is some evidence that the eosinophil cells of the anterior lobe of the pituitary are concerned with the stimulus to growth, whilst the basophils are in relation with the gonads (H M Evans and M E Simpson, *Jour Amer. Med Assoc*, vol 91, p 1337, 1928) It is to be noted that the hormones of the pituitary act through the ovary, in the absence of the latter none of the effects upon the secondary sex characters are observed The exact relationship between the anterior pituitary and the cyclic function of the ovary is not known, nor whether the secretion of hormones from the former is periodic.

The thyroid also has an influence upon the gonads,

but whether direct or secondary to its coincident effect upon the general metabolism of the body is not known G R Cameron and A B P Amies have shown that the administration of the dried gland to mice and guinea pigs leads to a prolongation of œstrus, especially in the latter, and also to prolongation of the whole cycle in the mouse (*Austral Jour Exp Biol and Med Sci*, vol 3, p 37 1926) Feeding fowls with thyroid produces changes in the plumage, which in males takes on a henny character (F W R Brambell, *Proc Roy Irish Acad*, vol 37 B, p 117 1926 M Nevalonnyi, *Bull de l'école super d'agronomie*, Brno, 1928) but Brambell considers that this effect is not physiological but due to the toxic results of the dosing, which produces hyperthyroidism Apart from this change in type thyroid feeding has the same effects in both sexes B Zawadowsky (*Jour biol méd expér*, vol 5, p 344 1927) has found that testicular degeneration in cocks and failure of egg laying in hens follows the administration of thyroid, again presumably a toxic effect

It may be remarked in passing that the secretions from both the anterior lobe of the pituitary and the thyroid gland are essential for growth and maintenance of normal health and any derangements will presumably affect the gonads just as the other tissues of the body on the other hand alterations of the œstrous rhythm may occur independently of other obvious bodily changes, suggesting that these glands may have a specific influence on the gonads or that the latter are more sensitive to their stimulation than the somatic tissues of the body

THE TESTIS

The male sexual gland is responsible for the development of the secondary sexual characteristics, as the ovary is in the case of the female Like the latter organ, it consists of cells from which the specific sex cells are developed and also of interstitial cells which lie between the seminiferous tubules it is generally held that the latter are the source of the hormone responsible for the appearance and maintenance of the secondary characters, since an organ in which the tubules have degenerated, such as an autotransplant, can still produce an internal secretion Testes always become functionless, so far as regards the formation of spermatozoa is concerned, when removed from the scrotum, either by transplantation or by fixation in the abdomen, and the same phenomenon is observed in naturally undescended organs, as in the case of unilateral cryptorchism in a rat described by W P Kennedy (*Jour Anat*, vol 61, p 352, 1927) The degeneration appears to be caused by the higher temperature to which the organ is exposed

On the other hand, some authors consider that the function of the interstitial cells is nutritive rather than internal secretory, basing their opinion on the histological appearances of these cells and on the presence in them of lipoid granules which are not specific in nature and may also occur in cells of the tubules which give rise to the spermatozoa (M Parizek, *Publ Biol de l'école vét*, Brno, vol 2, p 293, 1923 S Morgenstern, *Jour médico biol*, Fasc 4, p 29, 1925) In this case the internal secretion of the testis must presumably come from the external layer of cells of the seminiferous tubules which usually survive in a degenerated organ

The influence of the male gonads on metabolism has been followed after both castration and also the injection of testicular extracts In general, the results obtained so far have been rather inconclusive since they are irregular and slight in degree T C Shen and K H Lin have found no appreciable difference between the nitrogen excretion in the urine of eunuchs and normal men creatine was found in one case and the daily output of creatinine was variable in another, whereas normally creatine is absent and the creatinine excretion constant (*Chinese Jour Physiol*, vol 1 p 109 1927) Castration has no effect upon the level of the blood calcium (L Perelman *Jour medico biol*, Fasc 3, p 52 1925)

V Korenchevsky has investigated the effects of castration and injection of extracts of testis and prostate upon the metabolism of rabbits and dogs in a series of papers (*Brit Jour Exp Path*, vol 6, pp 21 74 and 158 1925 *Biochem Jour*, vol 19, p 772 1925 vol 22 pp 482 and 491, 1928) The development of obesity after castration does not always occur when it does it is accompanied by a decrease in both the nitrogenous and non nitrogenous metabolism there is little change in the metabolism if obesity fails to develop It is possible that these differences are due to variations in the response of the other internally secretory glands to absence of the testes Injection of prostatic extracts increases the nitrogen output in castrated but not in normal dogs, and a similar result was observed in the rabbit Injection of testicular extracts decreases the nitrogen metabolism Experiments on thyroidectomised animals indicated that the prostatic extracts acted on the metabolism by stimulating the thyroid gland whilst the effect of testicular extracts is similar to that produced by injections of insulin, so that part at any rate of the influence of the former is due to the presence of the latter hormone in the extracts, as confirmed by examination of their blood sugar reducing power

In the last two papers Korenchevsky has examined the influence of lipoid extracts and of watery extracts fractionated at various reactions atrophy of the secondary sexual organs in rats was not prevented by injecting these extracts, and the effects on the metabolism of rabbits were usually an increase in the nitrogen metabolism, provided that the thyroid gland was present It is doubtful how far these results can be ascribed to the presence of a specific hormone in the extracts maintenance of the secondary sexual organs in a functional condition in the castrated animal would appear to be a true index of the presence of a specific principle, and this has not yet been accomplished

In conclusion, a few words may be said on the subject of rejuvenation A critical investigation of Voronoff's experiments on the improvement of live stock has been presented by F H A Marshall, F A E Crew, A Walton, and W C Miller (Ministry

Agric and Fisheries, Board of Agric for Scotland) The investigators concluded that the methods of experimentation were not sufficiently critical to enable an answer to be given to the question of whether testicular grafting can improve the fertility of old stud bulls or the production of wool by the offspring of grafted rams In any event the economic importance of such experiments for Great Britain is probably only slight It is necessary to bear in mind that a testicular graft, to give satisfactory rejuvenation, must not only maintain the secondary sexual organs and characteristics in full function and exert the normal influence of the testis upon the cells of the body, but also stimulate the subject's own organ sufficiently to enable it to produce living spermatozoa the former effect can be produced by secretions from the graft, but only the subject's own testis can render him fertile Testicular grafting is a useful method of investigating scientifically the secretory function of the testis its usefulness as a practical measure must still be considered not proven

Obituary

PROF GEORG KASSNER

DR GEORG KASSNER, emeritus professor of pharmaceutical chemistry and chemical technology, died at Münster on Mar 30, 1928, at seventy-one years of age From the *Chemiker Zeitung* we learn the following particulars of his life A native of Lüben in Silesia, Kassner studied at Basel, Zurich, and Breslau, and received his first appointment in 1884 at Breslau under Prof Poleck In 1891 he was appointed professor of pharmaceutical chemistry and chemical technology at the University of Münster, where for thirty-five years he directed the training of students of pharmacy He also took an active interest in municipal affairs, and served for fifteen years on the Town Council In his teaching Kassner laid stress on the use of volumetric methods of analysis, and his methods were adopted in many other institutes

The work which Kassner had begun at Breslau led to a method of preparing oxygen from the air by means of calcium plumbate One of the chief disadvantages of this method was the fact that it involved the use of carbon dioxide, and when Linde's liquid air process was discovered Kassner recognised its superiority But, being convinced that further progress in the economical production of oxygen from air would be on chemical lines, he set to work to devise improvements, and in 1911 he succeeded in finding an inexpensive method of preparing both oxygen and nitrogen from air by means of plumboxan, a mixture of sodium plumbite and sodium manganate This process works at 400° C, a much lower temperature than was needed for his older process, and, moreover, the use of carbon dioxide was eliminated

During the War, Kassner discovered in the double compound of barium metaplumbate and barium manganate a useful catalyst for the atmospheric oxidation of ammonia to nitric acid at 500° C In addition to the work on lead compounds, he published numerous papers on other chemical subjects

DR E F J LOVE

THE University of Melbourne has suffered a loss in the death, on Mar 8, of Dr E F J Love, formerly senior lecturer in natural philosophy A brother of Prof A E H Love, he was born in Weston-super-Mare in 1861, he became a scholar of St John's College, Cambridge, and, after a short period as lecturer in physics in Birmingham under Prof Poynting, he was appointed to Melbourne in 1888 While he maintained a close interest in all branches of physics, his main interest centred in geodesy and thermodynamics In 1893 he published an account of a measurement of g at Australian stations, and at the time of his death he was secretary of the geodesy committee of the Australian National Research Council Dr Love was president of Section A of the Australasian Association for the Advancement of Science in 1907, when he spoke on the thermodynamics of the voltaic cell, and during his teaching work in the University of Melbourne he came to be recognised as an authority on thermodynamics Acoustics was another interest, and during the last few years he has applied the results of Sabine to the remedying of some local halls that had been acoustically defective He was president of the Victorian branch of the British Astronomical Association from 1899 until 1903 At the end of 1927 he retired from active teaching duties, and he then presented to the University a valuable collection of scientific periodicals and works on geodesy

WE regret to announce the following deaths

Prof Henri Andoyer, professor of astronomy at the Sorbonne in Paris since 1903, and an associate of the Royal Astronomical Society, on June 12, aged sixty-six years

Prof Franz Keibel, director of the anatomical and biological institute, Berlin, and a member of the Prussian Academy of Sciences, author of the "Normentafeln" of vertebrate development, and with Franklin P Mall of "Handbuch der Entwicklungsgeschichte der Menschen", on April 27, aged sixty seven years

Prof Charles Moureu, professor of organic chemistry at the Collège de France and an honorary fellow of the Chemical Society, aged sixty-six years

Mr Robert Ridgway, member of the National Academy of Sciences, curator of the division of birds in the U S National Museum since 1876, who was a past president of the American Ornithological Union and an honorary member of the British Ornithological Union, on Mar 25, aged seventy-eight years

Dr Charles E de Medicis Sajous, professor of applied endocrinology in the graduate school of medicine of the University of Pennsylvania, and president in 1917 of the American Association for the Study of Internal Secretions, on April 27, aged seventy six years

Mr M R Oldfield Thomas, F R S, for many years assistant in charge of Mammalia, British Museum (Natural History), on June 16, aged seventy-one years

News and Views

WE have received from Dr W G Woolnough, geological adviser to the Australian Commonwealth Government, some comments on the leading article in NATURE of Mar 2, dealing with the place of biology in school science This article, while stressing the unfortunate consequences of the neglect of biology in the schools curricula, pointed out that unless biology was approached through the medium of physics and chemistry the discipline of exact and critical thinking that these sciences confer might be seriously weakened Dr Woolnough believes that "it is the very inexactness of the 'biological' sciences which trains those habits of observation as opposed to manipulation, and which brings out the faculty of discrimination which is the essential of true scientific research" But this is only true provided the student has already some basis of observational and manipulative training on which to develop his faculty of discrimination, the whole point of the article was to show that physics, chemistry, and mathematics could not be displaced from this service by biology

THAT this is so is well shown by the actual illustration given by Dr Woolnough in support of his views After much experience in teaching microscopical petrology he has found the heuristic method most effective The meaning of such terms as refractive index, double refraction, cleavage, etc, is demonstrated to the students, who are then encouraged to make their own discoveries, aided only by a simple tabular guide and their text books But this method is only effective because the working material can be relied on not to 'play tricks' with the young student Cleavage and double refraction, for example, are definite physical phenomena a doubly refracting crystal does not suddenly change its mind and become opaque for a few days, whereas superficially erratic behaviour of this order is a commonplace in biology Had his duties been connected with biological instead of non biological instruction—with, say, mycology instead of petrology—he would have been brought up against this essential difference It is precisely because exact physical science is the foundation of Dr Woolnough's teaching methods that be is able to use the method at all

CORNWALL has produced many distinguished engineers and men of science, but none more worthy than Humphry Davy It was therefore very fitting that Penzance should do honour to her most distinguished citizen, who was born just opposite the spot where his statue now stands, and where the celebration was carried out At noon on June 8 the mayor and council of Penzance and the following Sir Humphry Davy Rolleston, Col R Humphry Davy and his wife, and R. Davy (descendants of the family), Sir Ambrose Fleming, representing the Royal Institution; Dr J Symons (president), E H Davison (secretary), and members of the Royal Geological Society of Cornwall; J C. Tregarthen (president), T R. Paull (secretary), and members of the Royal Institution of Cornwall, H Jenner and W L Fox (past presidents), E W Newton (secretary), and members of the Royal Cornwall Polytechnic Society, W E T Hartley, principal, University College, Exeter, and others met at St John's Hall, and walked in procession to the statue, where a platform had been erected, and in the presence of many thousands several speeches were made

THE Mayor of Penzance, Mr W G Goodfellow, said in the course of his remarks We are met here to-day to do honour to the memory of one of the illustrious sons of this borough Of the three learned societies of Cornwall responsible for arranging these celebrations, two of the presidents are Penzance men, born near this spot, as also was the case with Sir Humphry Davy himself Dr Symons and Mr Tregarthen then laid a wreath of laurel on the monument Dr Symons, speaking on behalf of the three learned societies of Cornwall, said that a former mayor, Dr Richard Pearce, on the occasion of his laying the foundation stone of the present Market House in 1836, remarked that the site of the assembly would ever be considered as memorable It was here that the greatest philosopher of the age first devoted himself to that science which rendered his name immortal, "Humphry Davy was born in the house just below, where he resided with his parents until they removed to Varfel, Ludgvan, when he was six years of age" It is somewhat a remarkable coincidence that the laying of this wreath should have devolved upon two who were born within a few yards of his birthplace, and who are now the presidents of two of the Royal societies of Cornwall Mr J C Tregarthen, speaking on behalf of the scientific societies of Cornwall, thanked the Mayor for the civic welcome and said that Davy's almost last words were "I have added some little to the quantity of human knowledge, and I have endeavoured to add something to the quantity of human happiness" A public meeting was held in the Pavilion in the afternoon, at which the speakers were Sir Humphry Davy Rolleston, Sir Ambrose Fleming, and others

MR R A WATSON WATT announced in his Symons Memorial Lecture to the Royal Meteorological Society (see NATURE, April 6, p 545) that current weather maps were to be broadcast from Daventry (5XX), and a specimen synoptic chart as received by wireless was reproduced in our columns Arrangements have been completed by the Meteorological Office, Air Ministry, the British Broadcasting Corporation, and Messrs Wireless Pictures (1928), Ltd, for the experimental issue from Daventry (5XX) of such weather maps by the Fultograph process between 2 o'clock and 2 25 P M on Tuesdays and Thursdays, and transmission commenced on June 18 The map will be prepared by the Meteorological Office and is similar in form to those published in the Press It shows the conditions over the British Isles and the neighbouring sea areas, and is not only of interest to many who receive the official forecasts and like to visualise the conditions on which they are based, but

should also be of great value to those who have sufficient knowledge of the weather to be able to base forecasts for their own locality upon it The great difficulty in the past has always been to get weather maps delivered quickly enough for practical use to be made of them Wireless transmissions will overcome this difficulty, and though during the experimental period the 7 A M weather map will not be broadcast before 2 P M , should the experiment prove successful it may be possible to arrange for an earlier transmission

THE publication of two volumes of the Annual Report of the Bureau of American Ethnology within a short period of one another emphasises the extent and value to anthropological science generally of the researches which are being carried out under official auspices in the United States In the interests of research workers in other parts of the world it is to be regretted that publication of these reports is much delayed Early publication of a record of results is most desirable even if that means postponement of comparative study In this matter the promptness with which the British Museum has published the results of its investigations in Honduras is worthy of much praise and also emulation by other official institutions In the present case the forty second Annual Report, which was the earlier to appear, carries us only to 1925 Much important work has been done since then The forty first Report, which has only just appeared, covers the work of five years from 1920 to 1924 Although it must be recognised that the permanent value of these volumes lies in the "Accompanying Papers", in which members of the staff record the result of their investigations, yet the brief introductory reports of the chief, Dr W J Fewkes, are of the greatest interest to those in other countries who wish for an authoritative survey of the general trend of investigations in American archæology and ethnology In the present instance in the years under review there has been a great increase in popular interest in the aborigines, and this has strengthened a movement to preserve as national monuments important ancient sites of aboriginal culture It is also to be observed that a sense of responsibility towards the Indian is growing, a gratifying if somewhat belated sentiment

IT is interesting to note how, in the years covered by the forty first and forty second Annual Reports of the Bureau of American Ethnology, the area covered by the work of the Bureau is being extended to wider fields A beginning has been made in examining and attempting to preserve such vestiges of the ancient culture of Alaska as have survived Within the United States themselves, the south western area, not unnaturally in view of its cultural importance, for long almost absorbed the resources of the Bureau Now, however, attention is being turned to the south east To the forty second Report Mr John R Swanton contributes two papers dealing with the Creek Indians and one in which he reviews the information relating to the aboriginal culture of the south east to be found in the writings of the early English, French, and Spanish writers, as well as the material collected by himself The late Mr William E Meyer, a lifelong student of Indian antiquities and culture, though not a professional archæologist, is the author of a study of Indian trails of the south east A paper by the same author on two prehistoric villages in middle Tennessee is included in the forty first Annual Report The Gulf area, which falls within this south eastern zone, is peculiarly important for American ethnology, as the earliest inhabitants appear to have been a brachycephalic type such as is found nowhere else in America A third extension which will be of much moment for the work of the Bureau in the future arises from its responsibility for work in Hawaii As a result of a preliminary survey of the Hawaiian material, made when the Pan Pacific Congress was held at Honolulu, it has been pointed out that the study of Hawaiian culture involves an extension to Samoa and other parts of the Pacific—a suggestion which has already borne fruit, for since the date of this report much valuable work has been done by American investigators in the Pacific This emphasises the reflection from which we started, that early publication of these reports is greatly to be desired

THE Faraday Society is arranging a general discussion on "Molecular Spectra and Molecular Structure", which will be held at the University of Bristol on Tuesday and Wednesday, Sept 24 and 25 A general introduction to the subject will be given by Prof W E Garner and Prof J E Lennard Jones The subject will be discussed in three sections, namely, band spectra in the visible and ultra violet, which will be specially introduced by Prof O W Richardson , the Raman effect, to be introduced by Sir C V Raman , and infra red spectra, which will be introduced by Prof C Schaefer in respect of solids, Prof J Lecomte in respect of liquids, and Sir Robert Robertson in respect of gases Papers have already been promised by Mr S Barratt, Prof G B Bonino, Prof J Cabannes, Prof W E Curtis, Prof P Daure, Prof I W Ellis, Prof V Henri, Prof E Hulthén, Dr R C Johnson, Prof V Kondratjew, Prof E F Barker and Prof C F Meyer, Dr A M Taylor, and Mr F I G Rawlins In addition, contributions are expected from Prof R T Birge, Dr H A Deslandres, Prof F Hund, Prof R S Mulliken, and Prof R W Wood

As in the case of recent successful discussions arranged by the Faraday Society, all the papers will be issued in advance proof, and the authors will be invited to devote a few minutes only to directing attention to points which they deem to merit special discussion, so that there will be adequate time for a lively general discussion By the kindness of the Council of the University of Bristol, members and visitors will be accommodated at the newly opened Wills Hall Particulars of arrangements can be obtained from the secretary of the Faraday Society, 13 South Square, Gray's Inn, W C 1 Cheap railway facilities will also be obtainable for those attending the meeting In view of the exceptionally large number of guests from abroad who will be attending this meeting, it is expected that there will be a

correspondingly large attendance of British workers The Society extends a cordial invitation to all those interested, whether they are members of the Society or not, and in particular invites research students to be present

The dangers attaching to ignorant treatment and working of different types of land are well known to the practical agriculturist The subject was discussed (*Daily News Bulletin*, Science Service, Washington, D C) by Mr Paul Redington, chief of the Bureau of Biological Survey, when speaking at the banquet of the Third New England Forestry Congress held in Hartford, Conn After alluding to the fact that much of their forest land is more profitable for producing wood and game animals, Mr Redington expressed the opinion that in the present era of agricultural depression through over production it is a mistake to increase the area of farm lands by draining and breaking up of swamps and shallow lakes "Too largely", he said, "in the past such areas have been looked upon as something merely to be drained to get rid of the water and make the land available for the production of farm crops and live stock In many instances this has reclaimed land that was utterly unsuited for such production, and at the same time it has destroyed it for uses to which it might have been more profitably devoted So long as there is more land available than is needed for agricultural and live stock production, which is the case in the United States, extensive drainage projects are, in my opinion, misdirected effort " From a different view point the caution applies with equal force to Great Britain We are not in the position of having more land available than is required for agricultural purposes, but it is not in doubt that considerable areas of undeveloped lands in the country will not respond to expensive drainage operations and become thereby of value for agricultural purposes The first step in the treatment of much of this land is by way of afforestation Drainage works with the latter object in view are comparatively inexpensive and will not involve the larger scale and excessively costly operations (with probable disaster as their outcome) which are now being announced in some quarters as a panacea for unemployment.

In the May issue of the *Journal of Chemical Education* C A Kraus and S T Arnold describe the results of an investigation into the training which chemists should have before entering chemical industry They visited a number of industrial and research laboratories in the United States and collected representative opinions from research directors and works managers From a collation of these opinions, it appears that graduates who propose to adopt an industrial career should have a thorough knowledge of general analysis, particularly quantitative, a sound working acquaintance with fundamental organic chemistry, facility in the use of English; and a reading knowledge of foreign languages, especially German Training in industrial chemistry and in engineering was not stressed, but it was felt that the student should have a reasonably good equipment in mathematics and physics, emphasis being laid upon the importance of thermodynamics There was little demand for a knowledge of the latest developments of academic chemistry, but the desirability of a year's post graduate research was urged by practically everyone Stress was also laid upon personality It would be interesting to know the views of English industrial chemists upon this matter, since a large number—probably the majority of graduates in chemistry at British universities enter the chemical industries, and it is clearly of great importance to the country as a whole that they should reach their maximum efficiency as quickly as possible Incidentally the foremost position assigned to analytical chemistry may be commended to the attention of science masters in the schools, where there is a noticeable tendency to cut down analysis to a minimum

Reference was made in our issue of Dec 17, 1927, p 890, to the Belgian National Fund for Scientific Research which was inaugurated at the centenary celebrations held that year of the famous Cockerill Works at Seraing According to the *Times* of June 12, within a year a sum of no less than £640,000 was given by some 1200 subscribers, and grants have been made to 30 engineers and scientific workers to enable them to carry on original investigation under their employers Subsidies have also been allocated to research students The romantic story of the Cockerill firm, which employs several thousands of workmen begins with the Lancashire mechanician, William Cockerill (1759–1832), who after some adventures in Russia and Sweden settled in Belgium in 1799 and entered into a contract to supply spinning machines, thus introducing into that country an industry of which England had previously had a monopoly It was his sons Charles, James, and John who in 1817 founded the factory at Seraing, John, in 1835, becoming the sole proprietor He died of typhoid fever while on a visit to Russia in 1840, but in 1867 his remains were removed to Belgium Owing to the German occupation, the centenary of the works could not be celebrated in 1917, but on the one hundred and tenth anniversary of their establishment important gatherings were held, and it was then that the King of Belgium made the appeal for the creation of the National Research Fund

A preliminary programme has been issued for the one hundred and tenth annual meeting of the Swiss Society of Natural Sciences The meeting will be held at Davos on Aug 29–Sept 1, under the presidency of Dr W Schibler, and the proceedings will be divided up among seventeen sections The programme includes lectures by Dr W Mörikofer, of Davos, on problems of meteorological radiation research, by G Bener, of Chur, on mountain road construction and science, by Prof R Staehelin, of Basle, on the physiology of high altitudes, by Prof E Guyénot, of Geneva, on the hypothesis of morphological territories in biology, and by Prof R Doerr, of Basle, on the submicroscopic forms of life Excursions to the Swiss National Park, to one of the institutes for the study of the physiology of high

altitudes, to the Davos observatory, and to other places of interest, are being arranged All correspondence should be addressed to the secretary, Dr W Mörikofer, Observatoire physico météorologique, Davos Platz The titles of communications for the sectional meetings should be sent in by June 30

THE Annual Report of the Imperial Institute for 1928 is a record of many useful activities in the investigation of agricultural and mineralogical problems, the answering of inquiries, and the promotion of various educational projects Among the investigations there may be mentioned the examination of Tasmanian stringybark pulp, which showed its value in the manufacture of artificial silk, tests which prove that Indian hemp is equal to European hemp in its resistance to fresh and salt water, the suitability for brick and tile making of clays from various parts of the British Empire, and the examination of many mineral specimens These are only a few examples of the kind of work which now engages the Imperial Institute, and they show its importance in research into the economic value of various parts of the British Empire

A DESCRIPTIVE pamphlet on the Hudson Bay Region, with many illustrations and maps, has been issued by the Natural Resources Intelligence Service of the Canadian Government The forthcoming completion of the Hudson Bay railway to Churchill, in providing a new route to a vast region, revives interest in the resources of this part of Canada After physical and historical introduction, the pamphlet continues with a description of the forests, minerals, water-power, and game Gold, silver, and copper zinc ores have been located and in some places are being worked The pamphlet, which contains no exaggerated claim for this part of Canada, is an interesting example of the way in which lands that were formerly little known were assumed to be of no value, but are now proving relatively attractive and at any rate not unworthy of considerable attention

THE seventh congress of the Far Eastern Association of Tropical Medicine, held at Calcutta in December 1927, was the subject of an article in NATURE of Mar 3, 1928 The *Transactions* of the Congress are now in course of publication (Calcutta Thacker's Press and Directories) in three large volumes, each of approximately 1000 pages, of which the first has already been received. The growth of the work done by successive congresses may be traced by the size of the *Transactions*, which has gradually increased in successive issues; those of the congress held in Hong Kong in 1912 were contained in a single volume of 399 pages, while those of the sixth congress held in 1925 in Japan required two volumes and 2313 pages The present volume comprises the proceedings of Sections I and II—the subjects of medicine and dermatology, pathology, surgery, ophthalmology, gynæcology and diseases of pregnancy, mental hygiene and psychiatry, radiology, dentistry, State medicine, general and special hygiene, and maternity and child welfare. Eighty-seven papers, many of great interest, with the discussions which followed their reading, are contained in the present volume, which is illustrated by 61 plates, mostly in half tone The editor, Lieut Col J Cunningham, is to be congratulated on the result of his labours The two volumes still to appear, which will contain the papers on such subjects as plague, cholera, leprosy, tuberculosis, bacteriology, protozoology, malaria, kala azar, medical entomology, helminthology, diseases of nutrition and deficiency diseases, immunology and chemotherapy, and rabies, promise to be even more interesting than the present one to the general scientific reader

A NEW volume of that comprehensive work entitled "Nauka Polska" (Polish Science), published by J Mianowski, Warsaw, for the Institute for the Encouragement of Scientific Works, has recently been issued This quarto volume of nearly 700 pages is the result of the collaboration of seventy five leading scientific workers, who have reported upon the means of organising and developing education and research in science subjects in Poland Much attention has evidently been devoted to a consideration of the immediate and future needs of the scientific institutions in the nation's various centres of learning, but public attention is also directed to the progress already made during the past decade "Nauka Polska" not only includes the natural and physical sciences and their numerous subdivisions, but also gives an account of work in Poland on psychology, criminology, aerodynamics, technology, geography, ethnology, philology, architecture, etc Interest has hitherto been most concentrated on the applied sciences, such as the technology of the metals It will be recalled that the president of the country, Prof I Moscicki, is himself a distinguished chemist and was formerly director of the Chorzow Fixation of Nitrogen Industry in Polish Silesia. Until recently it was not possible to form an opinion of the extent of the scientific work which was being conducted in Poland since investigators published their results in Russian or German journals Whilst this is no longer the case, one difficulty remains, namely, the fact that researches appearing in Polish publications only become known to scientific workers abroad through the various abstracting journals.

THE Herbert Spencer lecture delivered at Oxford on May 14, 1929, by Dr C. S Myers had for its subject "Psychological Conceptions in Other Sciences" (London Oxford University Press 2s net) The speaker is thus reversing the conventional practice of interpreting the 'higher' sciences in the language of the 'lower' There is a growing belief among physicists that it is impossible to predict what an individual atom or electron will do or which of the possible jumps of a quantum will occur next The psychologist, whose chief preoccupation has been with the individual, even when that individual was recognised as part of a group, has found mechanism everywhere, yet prediction with regard to the individual impossible. Dr. Myers in the lecture inquires how far knowledge of the mental world is helpfully applicable to the material world. He

reviews various problems, such as the distinction between primary and secondary qualities, estimation of weight and appreciation of colour, the intensity of sensations, and shows how, with the development of knowledge, ideas of the 'absolute' have been gradually replaced by those of the 'relative' Physics also has progressed along a similar path, and in place of the older notions of substance and absoluteness is finding itself occupied more and more with structure and entities in themselves unknowable and unimaginable The lecture is very interesting and suggestive and the point of view original It should prove stimulating to all scientific workers who are interested in the more ultimate problems of knowledge

The Huxley Memorial Lecture for 1930 of the Imperial College of Science and Technology will be delivered by Prof Graham Wallas, emeritus professor of political science in the University of London, on Monday, May 5, 1930, at 5 30 P M

A small earthquake was recorded at Kew Observatory on June 10 The first tremors reached the Observatory at 23 h 7 m 51 s G M T The shock originated under the Arctic Ocean about 200 miles from the Norwegian coast and about 250 miles from Tromso, near latitude 71° N, longitude 9° E A large earthquake was recorded at the Observatory on June 17 The first tremors arrived at 23 h 7 m 37 s G M T, and the epicentre is estimated to have been about 12,000 miles away

The Albert Medal of the Royal Society of Arts for the current year has been awarded by the Council, with the approval of the president, the Duke of Connaught, to Sir Alfred Ewing, Principal and Vice Chancellor of the University of Edinburgh, "for his work on magnetism and his services to technical education" The Medal was founded in 1863 as a memorial to Prince Albert, and is awarded each year "for distinguished merit in promoting arts, manufactures, and commerce"

At a meeting of the executive committee of the Imperial Botanical Conference (1924), held in London on Jan 18 last, it was decided to arrange a short Imperial Botanical Conference to be held immediately before the International Botanical Congress in 1930 The Imperial Botanical Conference, which it is intended should last only one day, will meet in London on Friday, Aug 15, 1930, at the Imperial College of Science and Technology, South Kensington, S W 7 The agenda before the conference will be purely of a business nature The proposal to hold a further Imperial Botanical Conference in 1935, on lines similar to that held in 1924, will be discussed, and, if necessary, the appropriate organisation for convening the conference will be arranged Reports of the committees which have dealt with the resolutions of the 1924 conference will be received

The January-March issue of *The World's Health* (Vol 10, No 1), the organ of the League of Red Cross Societies, is presented to readers in quarterly form as an experiment. A survey of the present position of leprosy is commenced in this number, with articles on leprosy in Japan, Siam, and Columbia

The Medical Directory Guide to "British Spas and Climatic Health Resorts" for 1929, edited by Dr R Fortescue Fox, has been issued by Messrs J and A Churchill, 40 Gloucester Place, W 1, price 1s In formation is given of the medicinal waters and spas of Great Britain and of marine and inland health resorts, with the clinical indications which may influence the choice of a particular spa or resort for a patient

The monthly publication of the Air Ministry known as the *Marine Observer* fills an important place in meteorological research with its copious notes supplied by observers at sea on various phenomena, and its abundant charts and illustrations A feature of recent numbers has been the general articles compiled at the Air Ministry on various aspects of marine meteorology These are valuable chapters, not only to sailors, but also to students The May issue contains a long article on the formation, occurrence, and prediction of fog, and another article on the local winds of the Mediterranean and Black Seas The April number had an account, illustrated by many charts, of the distribution of ice in the western North Atlantic, with special reference to the work of the United States *Marion* expedition in Davis Strait in the summer of 1928

We have recently received copies of a number of *Leaflets* issued by the Ministry of Agriculture and Fisheries, which have been rewritten in order to bring them up to date with advances in knowledge The *Leaflets* deal with various pests affecting agriculture and serve to keep the farmer and grower advised as to the best practical measures for controlling such enemies Apple capsids are of particular interest because they have only become serious pests during the present century, and a good deal of research has been, and is still being, concentrated upon them The latest *Leaflet* on the subject was rewritten in August 1928 and revised in January 1929 in order to bring to public notice the results of recent practical researches Other *Leaflets* deal with onion fly, slugs and snails, insecticides, and kindred subjects

A catalogue of books on chemistry and chemical technology has been issued by Messrs H K Lewis and Co, Ltd, 136 Gower Street and 24 Gower Place, W C 1 It contains particulars of a large number of books arranged under a very convenient system of classification

Messrs Francis Edwards, Ltd, 83 High Street, Marylebone, W 1, have just circulated a handsome illustrated catalogue (New series, No 2) of some 1000 books, pamphlets, and engravings relating to North America, which should be of interest and value to geographers and historians The catalogue contains facsimile reproductions of the title pages of many of the works listed, also bibliographic notes on some of the volumes

Messrs. C. Baker, 244 High Holborn, London, W C. 1, have sent us a copy of the new issue of their classified list of second hand scientific instruments (No 94) This list is now sent out twice a year only As usual,

the list contains a comprehensive selection of micro scopes and microscope accessories, and there is a large section on surveying instruments, which, it may be noted, are let out on hire Arrangements can also be made for hiring other apparatus Other sections deal with projectors, telescopes of various kinds, and various physical apparatus

APPLICATIONS are invited for the following appointments, on or before the dates mentioned —A junior assistant at the Forest Products Research Laboratory, Princes Risborough—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S W 1 (June 25) A geologist in the Geological Survey Office, Department of Industry and Commerce, Irish Free State—The Secretary, Civil Service Commission, 45 Upper O'Connell Street, Dublin (June 26) A junior lecturer in the department of pathology of the University of Liverpool — The Registrar, The University, Liverpool (June 27) A head of the school of engineering at The Polytechnic, Regent Street—The Director of Education, The Polytechnic, Regent Street, W 1 (June 28) An assistant lecturer in machine drawing and design in the engineering department of the County Technical College and School of Art, Newark —The Secretary, County Technical College and School of Art, Newark (June 29) A number of junior assistants at the National Physical Laboratory—The Director, National Physical Laboratory, Teddington (June 29) A wireless engineer under the Government of Nigeria for the Posts and Telegraphs Department—The Crown Agents for the Colonies, 4 Millbank, S W 1 (quoting M/1267) An assistant lecturer in the department of biology of the Huddersfield Technical College—The Director of Education, Education Offices, Huddersfield A lecturer in chemistry and physics in the school of pharmacy of the Merchant Venturers' Technical College, Bristol — The Superintendent, Merchant Venturers' Technical College, Bristol A lecturer in building and civil engineering at the Royal Technical College, Salford—The Secretary for Education, Education Office, Salford An assistant in the mechanical engineering laboratory of University College, London—The Secretary, University College, Gower Street, W C 1

Our Astronomical Column

THE TOTAL SOLAR ECLIPSE OF MAY 9 —Dr Baade, of Bergedorf Observatory, was stationed at Sogod in the Philippine island of Cebu He reports in *Astr Nach*, 5650, that cirrostratus clouds interfered with the photography of the outer corona, but very successful plates of the inner corona were obtained, which show its structure clearly Rev T E R Phillips exhibited at the meeting of the Royal Astronomical Society on June 14 some prints of the corona obtained by Dr R Waterfield at Iloilo, Philippines The extension shown on these was about one solar radius, but the negatives showed it a good deal further There appeared to be much less extension of the corona near the sun's poles than elsewhere, this is a familiar feature at sunspot minimum but less common near maximum

THE FUTURE OF THE SUN —The above is the title of the first of three articles by Dr Harold Jeffreys on geology and the related sciences to appear in the *Realist*, the first is in the June issue Dr Jeffreys notes that the hypothesis of the contraction of a great rotating mass of gas with an accompanying shedding of equatorial rings (originally propounded by Laplace and developed by Roche, Helmholtz, Kelvin, Lane) was held by many astronomers up to the beginning of this century, it was gradually discarded on two grounds, it gave an insufficient time scale, and there were grave dynamical difficulties in connexion with the moments of momentum of the sun and planets

Part of the contraction hypothesis was held until the year 1924, the dwarf stars were supposed to be those that had contracted beyond the point of continuing to have a purely gaseous constitution, so that by Lane's law their temperature would now decline Eddington then concluded by theoretical reasoning that the rate of radiation of energy should depend almost wholly on the mass of the star On plotting the stars of known mass he found that both giants and dwarfs lay on the same curve, and that the state of perfect gas continued much longer than was previously supposed, owing to the stripping off of the outer rings of electrons in the stellar atoms. A strong confirmation of the correctness of this conclusion was afforded by the demonstration of the great density of the companion of Sirius, which at the same time gave a proof of the shift of spectrum lines in a strong gravitational field which Einstein had predicted

The energy of stellar radiation is now ascribed to the conversion of the stellar matter into light and heat, the details of the process are still obscure, but it is conjectured that colliding protons and electrons may cease to exist as matter, becoming simply radiation The energy in the atom is so great that the possible life of the stars is extended from a few million years to many millions of millions The former contradiction between the estimated past duration of the sun and that of the earth has thus been completely removed

THE OPACITY OF STELLAR ATMOSPHERES —The Bakerian Lecture at the Royal Society was delivered on June 6 by Prof E A Milne on the subject of the opacity of stellar atmospheres He notes that the problem involves the study of the property of layers of gas, given the amount of the energy flux, and the intensity of the gravitational field it is further necessary to consider the effect of changing temperature in comparing the different spectral types, and the effect of absolute magnitude in comparing different stars of the same spectral type It is pointed out that there is no sharp boundary between photosphere and reversing layer, but that one merges into the other The solution of the problem depends largely on study of the contours of spectral lines, that is, on the determination of their intensities at different distances from the centre of the lines The method is applied to a zinc triplet in the spectra of Capella (bright component) and the sun, which are taken as a typical giant and dwarf of type *G*0 The absorption coefficient κ is found to be 300 for the sun and 60 for Capella Miss Payne found $\kappa = 150$ for *A* type stars, which is in satisfactory accordance Once κ is known the number of atoms above the photosphere can be calculated on certain assumptions for the different elements It is shown that the dependence of κ on the electron pressure *P* is confirmed by the fact that observation indicates an effect depending on absolute magnitude for stars both at low and high temperatures.

Research Items

Sex and Infant Mortality.—The difference in the mortality of the sexes during infancy is one of the most significant indications available of the constitutional factor in disease. During infancy the environment is uniform for both sexes, so that variation in the mortality rate between males and females may be attributed to variation in the sex response to environmental factors. From this point of view, Dr. Harry Bakwin has analysed the infant mortality throughout the United States registration area for the ten-year period 1915–1924 inclusive (*Human Biology*, vol. 1, No. 1, 1929). Male mortality far exceeded female under one year of age; to every 100 female deaths there were 130 to 134 deaths of males. The difference is not confined to the first year, but is most marked at birth and decreases with age until in the fourth year the death rate is about equal for the two sexes. But there are two exceptions to the gradual decrease: on the third day of life the mortality difference between the sexes is more marked than at birth, and it is also more marked during the second month than during the first. Since 1900 there has been a fall in infant mortality, but it would appear that relatively more females than males have benefited, for coincident with the common fall there has been a rise in the sex mortality ratio. There are seasonal differences in the ratio as well as regional differences, England, Wales, and Scotland having a high ratio, whereas it is low in Italy, Japan, Jamaica, and Spain. In rural communities, moreover, the ratio is lower than in city areas.

A Pre-Islamic God of Arabia.—In the *Indian Antiquary* for May, Ch. Muhammed Ismail figures and describes an image of the god Wadd sculptured on a stone now in the Prince of Wales's Museum of Western India and formerly in the possession of the Bombay branch of the Royal Asiatic Society. The importance of this image is that out of a large number of Arabian sculptures and stones with inscriptions mentioning the god Wadd, this is the only one of which the words purport to say that it is the image of the god Wadd. Owing to a misreading, a decipherment by James Bird in 1844 failed to identify it. Wadd was the most important of the pre-Islamic gods of Arabia, that is, of the peace-loving and commercial citizens of Himyar and Saba, who differed widely from the wild Bedouin. All ancient Arabs wore talismans bearing his name, and temples were dedicated to him as the god of love and happiness. His image has been described by an Arab commentator as that of a tall man wearing a loin cloth with another cloth over it, a sword hanging round his neck, and with a bow and a quiver, in front of him a lance with a flag attached to it. The present figure differs. The god is shown as a short man wearing a kilt. On his head is a close-fitting cap with a long tassel which seems to represent a strand of hair. Bedouins who come to Aden from the hinterland still shave the lower parts of the head, but keep a tuft or sometimes a long strand of hair on the crown. The author comments on the neglect of Arabian antiquities by the Indian Government in Aden and its hinterland, which is under its jurisdiction, but notes that, stimulated by Sir John Marshall's interest in field work, the Aden Historical Society is taking up this important subject.

Adaptations of the Pelvis in Marsupials.—The marsupials show so wide a range of habits that a comparative study of the pelvis in relation to function has, in the hands of Herbert Oliver Elftman, afforded some clear evidences of special adaptation (*Bull. Amer. Mus. Nat. Hist.*, March 1929). Much of the adaptation is associated with locomotion. Thus in arboreal forms there are largely increased muscles of adduction and a more open acetabulum allowing greater freedom of motion of the femur. Leaping forms, with their exaggerated hind limbs, require an elongated post-acetabular portion of the pelvis to provide leverage for the hamstrings, the ilium has an outward flare, and there is a large ilio-sacral angle. Fossorial adaptation depends on the particular method of digging employed by the animal, but in general the ischium is long, the iliacus attains great size and is thus partly responsible for the broadness of the ilium. The shape of the pelvis, however, is also associated with other than locomotor factors. The gross form is determined by its relation to the viscera. Its width is influenced by the width of the trunk. The size of the sacro-iliac angle and the position of the sacro-iliac joint are conditioned by the size of the erector spinæ muscle and the necessity for an adequate pelvic outlet. The marsupial bones assist the abdominal musculature in the support of the viscera and protect the pouch from distortion during the contraction of these muscles.

Differentiation *in vitro* of Cartilage and Bone.—Dr. Honor B. Fell (*Archiv f. exp. Zellforschung*, 7, 1928) records the results of observations on the differentiation *in vitro* of cartilage and bone. Cultures of embryonic limb cartilage from 8-day fowl embryos were made by the ordinary coverslip technique. The explanted limb cartilage enlarged greatly during cultivation, and in several specimens differentiated into epiphysial and diaphysial regions. After 10–12 weeks' growth *in vitro*, a proportion of the explants were in a healthy condition. Cultures of undifferentiated limb-bud mesenchyme from 3-day fowl embryos exhibited chondrogenesis although the tissue was spreading over the surface of the coverslip. Cartilage thus formed *in vitro* sometimes remained in a healthy state during three months' cultivation but underwent no differentiation into epiphysial and diaphysial regions. After 3–4 weeks' cultivation, ossification was observed in several cultures and the progress of bone deposition followed in the living explants.

Interrelationships of the Echinodermata.—An exhaustive discussion of the major systematics of Echinodermata, based on anatomical, embryological, and palæontological evidence, is offered by Prof. D. M. Fedotov, of the Russian Academy of Sciences (*Travaux du laboratoire zoologique et de la Station biologique de Sébastopol*, Série 2, No. 12, Leningrad, 1928). Pelmatozoa are regarded by the author as the group which has given rise to other Echinodermata. The sea lilies are derived by him from Cystoidea, while a discussion of the anatomical, embryological and palæontological evidence on sea urchins leads him to the conclusion that this group stands quite isolated amongst other classes of the Eleutherozoa, there being no definite grounds for suggesting a relationship between sea urchins, star fishes, and holothurians; the origin of sea urchins was probably in the Cystoidea Diploporita. Star fishes and ophiurs the author believes to have originated from the Edrioasteroidea, though there is no direct evidence in favour of this view. Holothurians are an exceedingly ancient group, dating back perhaps to Palæozoic times, and originated independently from sea urchins, star fishes, and ophiurs, but still must be considered as belonging to the Eleutherozoa.

ALIENS IN THE FLORA OF VICTORIA.—In an interesting note on the naturalised aliens in the flora of Victoria (*Proc. R. Soc. Victoria*, 41, 1928) Prof. A. J. Ewart states that in 1909 the number of aliens recorded was 363 and in 1928, 461. This rate of increase, slightly more than five per year, has been maintained with remarkable uniformity for the past sixty years. The aliens include the clovers, trefoils, medicks, most of the more valuable pasture grasses, and some garden plants that have run wild. Less than a hundred of the aliens are serious weeds, and few of them so serious a menace as the native bracken on newly cleared forest land. The transport of fodder is probably responsible for the relatively high proportion of aliens contributed by South Africa, which include some of the worst weeds. Prof. Ewart considers that owing to the competition of imported aliens and the pressure of settlement, probably less than half of the original flora (about 3000 species) will survive within fifty years and many originally widespread plants will be confined to special localities. Were it not for the disturbing factors introduced by man, the spread of the aliens might have been used as a test of Willis's age and area hypothesis. Among the interesting cases cited are: the evening primrose (1887) has covered less ground than the foxglove (1917), the musk weed *Myagrum perfoliatum* (1916) has become more abundant than the horehound *Marrubium vulgare* (1870), and the stinkwort, *Inula graveolens* (1893), rapidly overtook the stinkweed *Gilia squarrosa* (1887), both in area and abundance. Even taking species of the same genus, it appears that the time factor is of far less importance in determining the area covered by a species than its suitability to new habitats, its means of distribution, its aggressiveness and its resistance to foes and injurious agencies. "It seems probable that the age of a species is one of the least important of the factors governing its distribution, and that in only few cases can a relation be traced between the age of species and the area they cover at the present day."

JAPANESE HEPATICS.—The first part of what should prove an important series of papers upon the Hepaticæ of Japan, by Yoshiwo Horikawa, has appeared in the *Science Reports* of the Tôhoku Imperial University, vol. 4, No. 1, series 4. The author points out that more than 500 species are already reported for Japan, of which no less than 65 per cent are endemic. In the present contribution, species of two very interesting genera are described, *Makinoa* and *Schiffneria*. In the case of *Makinoa*, it is interesting to note that the constriction of the thallus, at the point where the sexual organs are developed at the close of the season, enables the different annual increments of growth to be distinguished. In this way six or seven years' growth contributions can sometimes be separated in the same specimen. Field observations of this kind upon the age of patches of liverwort seen growing in Nature are not very common.

THE KARAKORAM RANGE.—The *Records of the Survey of India*, vol. 22, contains Major K. Mason's account of his explorations in 1926 in the Shaksgam and Upper Yarkand valleys and the Aghil Ranges, with a map on a scale of 1 inch to 4 miles. The report contains a full illustrated account of his travels and a number of appendices on geology, natural history, etc. In discussing the nomenclature of the area, Major Mason points out that the term in general use, Karakoram Range, is a misnomer and that it means literally 'black gravel', and was first applied to the high pass on the route between India and Yarkand. From this pass the term came to be applied to the iciest range of mountains outside polar regions, on which the actual pass does not lie. Accepting the usage, however inappropriate it may be, Major Mason proposes to use the term Karakoram Himalayas to the whole mountainous area and to distinguish within it three main ranges. Of these the southern he proposes to call the Kailas Karakoram, the second he terms the Mustagh Karakoram, and the most northerly the Aghil Karakoram. To the north-east of this last range lies the Aghil 'Red' Range, which, however, Major Mason was unable to visit. The merits of this nomenclature are discussed at length in the report.

OIL WELL 1½ MILES DEEP.—Some idea of the astonishing progress of petroleum production engineering methods is obtainable from a record set up by an oil company operating in West Texas, U.S.A., which succeeded in drilling a successful oilwell to a depth of 8523 ft. below surface. Not only does this represent a wonderful engineering feat, but at one period a measured production of 1125 barrels of oil and an estimated production of some 12 500 000 cubic ft. of gas, indicate the discovery of pools of no mean consequence. The well formed part of the deep test programme at Big Lake oilfield, and was brought in towards the end of last year. In this region of Texas, known as "West Texas", a thick Permian limestone-marl and anhydrite series is exploited principally, but the depth of this particular well leads to the inference that Pennsylvanian beds (Upper Carboniferous) have been penetrated. It is noteworthy that of the 8523 ft. drilled, 2339 ft. represents 'open hole', $5\frac{3}{16}$ inch casing being set at 6184 ft. There is no reason why drilling should not be carried deeper so far as these data go, but the very high rock pressure at such depths would tend to exert a controlling influence, while the natural flow of oil and gas in the quantities stated implies similarly high fluid pressure. The temperature of the oil (flowing) was 49° F. The question has often been raised concerning the economic depth of ordinary drilling, attempts having been made to state a maximum beyond which cost of drilling and control would outweigh values yielded by the oil obtained; where pumping costs have to be added, the problem is further complicated. It would seem, however, that deep well drilling is an accepted policy to-day, and if in the future (when oil prices appreciate) the location of deeply buried pools, in fields already exploited for their shallower production becomes a matter of necessity, there is little doubt that this record will be broken, if it has not already been in the case of other previously projected deep wells.

EINSTEIN'S UNIFIED FIELD THEORY.—Mr. G. C. McVittie, in the June issue of the *Proceedings of the Royal Society* (No. A, 794), has provided a supplement to Einstein's somewhat abstract account of the new theory by showing in detail how it can be applied to a simple case. For an electrostatic field uniform in direction and nearly constant in magnitude, but with a slight exponential change of strength as we go along the field, it is possible to obtain exact solutions of the gravitational and electromagnetic equations of the older general relativity theory. These solutions are then substituted in the corresponding equations of the new unified theory. As a result it is found that the new equations are satisfied to the first order but not to higher orders. This shows clearly to what extent Einstein's new equations differ from his old ones. It will be recalled that in a letter to NATURE of May 4, p. 678, Prof. Levi-Civita outlined a modification of Einstein's new theory, with the object of obtaining exactly, and not merely to the first order, the older equations on a unified basis. Mr. McVittie would perform a useful service if he would exemplify Levi-

Civita's theory by applying it to the simple case mentioned above.

Radio Intensity Measuring Apparatus.—The utility of high frequency radio transmission systems and their extending use has created a demand for an instrument capable of measuring the strength of the magnetic field at any point. J. Hollingworth and R. Naismith read a paper on May 1 to the Wireless Section of the Institution of Electrical Engineers describing a portable apparatus suitable for measuring the absolute strength of the field produced by these currents. An instrument suitable for measurements of this kind can rarely be made by merely altering the electric constants of apparatus suitable for low frequencies. Resistance, capacity, and inductance are no longer constants at high frequencies. The set consists of a detector valve and a control valve. One stage of audio frequency amplification follows the detector, and a two terminal thermionic valve allows a galvanometer to be used for the signal comparison. A separate heterodyne is used to obtain the audio frequency. The instrument is capable of measuring the intensity of the magnetic field over a radio band of 5 to 12 megacycles per second. Without batteries it weighs about sixty pounds and so can be carried in a light car. The authors use an aerial connected to one end of a high resistance, the other end being earthed. The discussion of high frequency measurement aerial effective height, and wave attenuation all come into the problem. The method adopted, therefore, is to subject the instrument to searching tests for internal self consistency and then test it out of doors on local transmissions. The results enable the experimenter to determine whether the instrument is reasonably accurate or not. Experimental results are given showing the kind of accuracy obtainable. The work carried out by the authors is part of the programme of the Radio Research Board.

Boric Acids.—Various compounds of boric anhydride with water in different proportions have been described, but the only two boric acids definitely known in the solid state were orthoboric acid, B_2O_3, $3H_2O$, and metaboric acid, B_2O_3, H_2O. By means of vapour pressure determinations in the series B_2O_3–H_2O and measurements of the weights of water lost in passing from one part of the system to another, L. F. Gilbert and M. Levi have been able to show that probably there are eight compounds of the type nB_2O_3, H_2O, where $n = 1, 2, 3 \ldots 8$. This work is described in the *Journal of the Chemical Society* for March, and an approximate value for the heat of hydration of boric anhydride to orthoboric acid is given. This value differs considerably from previous ones, which are thought to be inaccurate.

Experiments with Carefully Dried Substances.—The *Proceedings and Transactions of the Nova Scotian Institute of Science*, vol. 17, Part 2, contains an account by D. McIntosh of attempts made to prepare carefully dried substances by employing low temperatures. A mixture of carbon monoxide and oxygen may be dried by cooling in a solid carbon dioxide–ether mixture, as was shown by Girvan, and after being kept in the freezing mixture for some hours cannot be exploded by an electric spark. The gas explodes, however, at about $-50°$, when there is about 1 molecule of water present in 40,000 molecules of gas. A similarly treated mixture of nitrous oxide and carbon monoxide always explodes at $-80°$. Other experiments on intensive drying by cooling were not successful, probably on account of the difficulty of removing the water film from the glass surface of the apparatus. Thus, the reaction between hydrobromic acid and ammonia could not be inhibited, although the vapour pressure of the water was reduced to one thousandth of a millimetre.

Non-Existence of Isomerism among the Dialkyltelluronium Dihalides.—Two forms of dimethyltelluronium dihalides were obtained by Vernon and from them two distinct bases, and he accordingly postulated the existence of two series (α and β) of isomeric compounds. He concluded that the tellurium atom had a planar distribution of valencies and suggested formulæ of the type

$$\begin{array}{c}\begin{matrix} I \diagdown & & Me \\ & Te & \\ Me & & I \end{matrix}\\ (\alpha\text{ di-iodide red})\end{array} \qquad \text{and} \qquad \begin{array}{c}\begin{matrix} Me \diagdown & & \diagup I \\ & Te & \\ Me & & \diagdown I \end{matrix}\\ (\beta\text{ di-iodide green})\end{array}$$

More recently this isomerism has been explained by assuming from the electronic point of view that the halogen tellurium linkages are non-equivalent (see NATURE, April 6, p. 547). In the *Journal of the Chemical Society* for March, H. D. K. Drew gives an account of a re-examination of the dimethyltelluronium di-iodides and dibromides and the two bases. He concludes that the members of the β series are not isomeric with the α compounds. The α compounds appear to be of normal type, are in general non-polar, and the tellurium atom in them probably has a tetrahedral distribution of valencies. The β compounds are complex substances resembling salts, but having the same empirical formulæ as the members of the series.

Preservation of Timber.—At the Glasgow meeting of the British Association, a paper was read by Prof. Percy Groom on the "Antiseptic Preservation of Timber" (published in *Empire Forestry Journal*, vol. 7, No. 2, 1928). In his paper Prof. Groom correctly states that the antiseptic preservation of timber is "usually regarded as merely a means of decreasing the damage done to timber by fungi (and insects); but when properly applied it can result in a positive increase of the available supplies of commercial timbers and thus be equivalent in effect, to increase of production and may thereby become closely linked with forestry." The author deals briefly with the losses incurred in the British Empire by decay to timber due to want of adequate preservation and the increased supplies which would result from a better economic utilisation of the available amounts. Such questions have received a great deal of attention at the Research Institute at Dehra Dun, where the first commencement in this line of research in the British Empire was made. Prof. Groom deals with his subject in a highly informative manner, and his paper should be studied by all interested in timber and its utilisation. What from the practical utility point of view, may be considered a side issue but one of considerable scientific interest, is the author's reference to the interaction of fungi and insects in the destruction of timber, a line of research which promises to be of considerable interest. Prof. Groom's theme did not include this study, but it is alluded to as follows: "The destruction of timber by fungi that cause rot and by insects that burrow into wood may be lessened by a *septic sanitation*, that is to say, by the adoption of measures designed to decrease the production of spores or eggs and to render the external conditions unfavourable to the activity of these organisms." Prof. Groom states that a combination of sanitation and antiseptic treatment gives the best economic results, but his paper is confined to the latter and omits a consideration of insects. His remarks on this subject are of interest.

The South-Eastern Union of Scientific Societies

CONGRESS AT BRIGHTON

THE thirty fourth annual congress of the South Eastern Union of Scientific Societies was held at Brighton on June 5–8, Sir Arthur Keith occupying the presidential chair in succession to Sir Martin Conway

In his address Sir Arthur took as his subject "The Pre Roman Inhabitants of Southern England" His endeavour was to trace the people of southern England from the coming of the Beaker folk about the beginning of the second millennium B C to the time of the arrival of the Romans The remains of the Beaker folk that have been found with the aid of the pick and shovel have possibly traced that race up to about a thousand years B C, and going backward from Roman times, the folk that Sir Arthur called the 'pit diggers' have possibly been traced back to 600 years B C Between these two dates there is a wide interval of which we seem to have no records, and it is this interval that archæologists are endeavouring to fill in Southern Englishmen of pre Roman times have been disinterred from time to time from the Downs of chalk, which show that they all had certain well defined common cranial characteristics, and they all have affinity to the Beaker folk who began to invade England from central and north western Europe some 2000 years before the Christian era

From the remains that have been found at Blackpatch, near Worthing, it is possible to infer what was the mode of life of these folk These early Downsmen grew their corn and ground it They domesticated certain cattle, such as the ox, the sheep, and the pig, and were no longer purely hunters They had looms The red deer they hunted and used the antlers as effective mining tools They fabricated flint implements of the same patterns as those from the neighbouring mines of Cissbury

Speaking of the finds of Beakor folk in the neighbourhood of Brighton, Sir Arthur first of all referred to the skeleton of a woman who had been laid to rest in a grave that was cut into when a trench was made for carrying a cable to a golfing club house on the east of Brighton The body was laid on its side with the limbs folded on the body There was also here the crouched skeleton of a child some two months old The oval pit in which they had been laid had been completed by covering it with a layer of flint cobbles Unfortunately there was no grave furniture, no coin, shard, metal, or ornament to show the date at which the woman and child "ceased to breathe the fresh air of the South Downs' Although her skull was of the long type, there were certain features that showed affinity to the Beaker type, a type that is known by its flat vertical occiput, its strong face with rugged features the eyebrows being usually very prominent and the forehead receding The type is still frequently seen in England, and it was stated that men of the type are often leaders in communities, Darwin himself reproducing its features

There appear to be two circumstances which give a clue to the identification of the Beaker people, the crouched position in which they are buried, and the covering of the grave with flint nodules Another burial was uncovered in north Brighton in which a woman was buried in a similar position, and although she was long headed there were traces of Beaker ancestry She is known as the Maycroft skeleton Another crouched burial was laid bare at Moulscombe pit, to the north of Brighton, where a male counterpart of the Beaker woman was found Another burial was discovered when the Ditchling Road was extended to the north, when a male skeleton was disinterred, but his skull was somewhat wider and his face shorter than the Moulscombe man In this case a beaker was found, of the kind used in England in the early part of the second millennium B C, and with it was a barbed flint arrow head under the skull Several other graves have been found of a similar nature

Sir Arthur then referred to the ancient flint mines of Blackpatch and the barrows nearby, whence the skeletons proved to be the same folk as the Brighton people One proved to have had a remarkable head It was not the typical Beaker head, for it was both long and wide, being 195 mm by 155 mm, and it has been thought that it represented a cross between long headed and round headed stocks The graves were destitute of grave furniture and the men were probably the miners who dug the flint mines close at hand A crouched burial of a man with all the characters of the Beaker breed was taken from a barrow on the heights above St Catherine's Point in the Isle of Wight On the Downs at Nunwell, 12 miles to the north, a skeleton was found in 1881, and the contents of this grave are preserved in the Carisbrooke Museum With it was buried a lugged pot like vase, which was thought by Mr Crawford to have been fabricated in the upper valley of the Rhine, possibly towards the end of neolithic times The trail of the Beaker men has been traced through Belgium into England and along the Kentish Downs, and in all cases the resemblance is great Sir Arthur raised the question as to whether the Beaker folk practised child sacrifice It may be that by coincidence a child died at the same time as the adult with which it was buried, but in quite a number of cases a child was buried with the adult, and this has been found to have been the case at Brighton, on Dunstable Down, in Belgium, and at Worbarrow Did the Beaker people sacrifice children to give youth to their dead, or was an adult sacrificed to guard the child in the realms to which it had gone? The Beaker blood appears to have been swamped as time went on by that of the ancient natives of England

Mr Hadrian Allcroft, in addressing the Archæological Section, asked the question as to what was the earliest church, and adduced evidence to show that a church was at first an open air enclosure, and was not a building at all It was really a burial place, and a walled in church was later than the burial ground in which it stood The Scotish Christianity from Ireland was introduced after the withdrawal of the Romans, and for many centuries looked with disfavour upon any church building of any kind The circular place of burial would enclose a few beehive huts for the monks, but no reference can be found that in the earliest days there was any place for united worship A Christian must be buried before the enclosure could become consecrated ground, and if Nature failed to provide this, the early Christians obtained a voluntary sacrifice of a human life In the case of the founding of the monastery at Iona St Oran volunteered to go to heaven, and was buried on the spot selected for the monastery

The excavations at Blackpatch, near Worthing, made by Mr J H Pull and Mr C E Sainsbury, were described by the former The position of this prehistoric site is on the borders of an old road running along a spur of the Downs 2½ miles west of Findon, at between 300 and 400 feet, O D Here was found a mine field containing a closely grouped series of pits sunk through the chalk until a seam of good flaking flint was reached in the zone of *Actinocamax quadratus* Many of the shafts were cleared

and low horizontal galleries were found at their base radiating therefrom Close at hand were open air hearths, sunken hut floors and a series of round barrows, and these barrows have yielded valuable evidence of the Beaker men who excavated the flint

Following the address by Mr A D Cotton, of Kew Gardens, on "The Importance of the Study of Systematic Botany", a paper was read by Dr Geo Morgan on wood nodules on trees, in which he made a clear distinction between sphæroblasts, or hard knobs of wood existing independently of the inside wood of a tree, and burrs or irregular excrescences from the layers of the wood Sphæroblasts or woody tumours appear to be in the vegetable kingdom a parallel to the tumours in the animal kingdom known as dermoids

Dr G P Bidder took "Death" as the subject of his presidential address to the Zoological Section He held that death was biologically a new thing relatively, and that senescence and natural death were not necessary attributes of life There is no such quality of protoplasm as inherent or intrinsic senescence That part of a living body that is not converted into protected spores, gemmules, or eggs is the body that undergoes the process of natural death There is reason to believe that the female plaice and certain anemones do not die, except by accident

The distribution of certain Sussex birds and insects was dealt with by Mr A F Griffiths Mr Reginald Smith gave a public lecture on "Early British Art", and showed that before the Romans came over the Britons had achieved a decorative art of the highest order It had its origin in classical art, chiefly of the Greeks of the age of Pericles, moulded by Roman influence later The artistic but warlike Celts had made a Greek settlement on the Rhine about 440 B C, and as at this time this country was called Britain it was perfectly correct to speak of Celtic art in relation to British discoveries found about that period

In the Geological Section, Mr Henry Dewey gave an address on "The Denudation of the Weald" and Mr Edward A Martin read a paper on "The Brighton Pleistocene Cliff Formation" The presidential address to the Regional Survey Section was read on behalf of Prof H J Fleure and dealt with various aspects of regional work and this was followed by a paper by Mr David Edwards, the Brighton Surveyor on "Town and Regional Planning"

The Congress included a reception by the Mayor, Alderman H J Galliers and a number of excursions were made to places of interest in the county

The Strangeways Research Laboratory, Cambridge

THE trustees of the Strangeways Research Laboratory, Cambridge (Sir Humphry Rolleston, Prof H R Dean, Prof Malcolm Donaldson, and Sir Charles J Martin), have issued an attractive little pamphlet setting out briefly the history of this remarkable institution Beginning in 1907 in a small house as a research hospital with three beds for the study of rheumatoid arthritis, it has gradually developed into a research institute devoted entirely to the study of tissue culture both in its general biological and its more strictly medical aspects Though still small and not too well endowed financially, it has now taken a leading place among the research laboratories This remarkable achievement has been brought about through the lovable personality, the selfless devotion, and the patient, persistent, careful work of the late Dr T S P Strangeways, who died two years ago Neither academic distinctions nor scientific honours came his way, but no scientific man could wish for a finer reward than to have his name associated with an institution such as this laboratory

Although radium is being used more and more extensively in the treatment of cancer, its use is still almost entirely empirical, for until recently little was known of its mode of action on either the normal or the malignant cell This was one of the problems which had engaged the attention of Dr Strangeways during the last few years of his life, and by applying radium to cells cultivated *in vitro* and following the subsequent effects under the microscope in the living cell, he and his pupils have succeeded in obtaining information which has thrown a new light on this obscure problem, and has revealed the inadequacy of some of the *a priori* conceptions current among clinical radiologists

The beautiful kinematograph films of Dr Canti which many of our readers may have seen and admired were made in collaboration with the Strangeways laboratory This and other work is being continued and it comes rather as a shock to find from the trustees' report that up to the present neither the director nor any research worker has received payment from the funds of the institution "This gift of service has in most cases been rendered possible only by the aid of fellowships or research grants from other sources The tenure of benefactions of this kind is, however, limited to a few years, and if the excellent work which is being carried out at the Strangeways Research Laboratory is to continue and the foundation remain in its present form—a monument to the unselfish enthusiasm of its originator—its income must be increased sufficiently to enable it to provide salaries for a small permanent staff"

The staff consists of five research workers, with Miss Honor Fell as chief of the laboratory This year a course of instruction in the technique of tissue culture will be given at the laboratory on July 9–Aug 10 Since only a limited number of applicants can be received, notification from those wishing to take the course should be sent not later than June 30 to Dr H B Fell, Strangeways Research Laboratory, Cambridge

Sugar Beet in England

THE progress of the sugar beet industry in England has been followed with the closest attention since 1924, but the interest naturally increases with the approach of the end of the term of years during which the Government subsidy is in operation The question which confronts the English farmer is not whether the crop can be grown in England, but whether it can be grown *profitably* when faced with the competition of the open market. Experiments of various kinds have been carried out in different parts of England to make a thorough investigation as to the best methods of cultivation, manuring, and harvesting, and at the same time the continental procedure has been closely studied in order to make the best possible use of their longer experience It seems generally clear that profits can be made at the present time (about £5 per acre being quoted as an average from one area for last year), but the closest co operation must be

built up between the growers and the factories, and costs still further decreased, before the industry can safely be regarded as self supporting Improvements made by the farmer will be of little avail if the crop is not marketed economically

A comprehensive review of the situation is given in the 'Report of the Second Sugar Beet Conference", held at Harper Adams College, and also in an article by E C Pretyman in the *Journal of the Royal Agricultural Society*, vol 89 It seems generally agreed that beet can be grown on a number of soils, but that the best crops are obtained on a deep soil there must be no deficiency of lime Seed should be sown plentifully on a carefully prepared seed bed in late April or early May, a dressing of dung if possible having been given to the preceding crop or in the previous autumn, though artificials can usually be applied with advantage instead Early singling is of the greatest importance, the distance between the plants not exceeding ten inches the spacing between the rows should be the smallest possible to allow of thorough cleaning Lifting should take place as soon as the crop is ripe usually from mid October to mid November, in order to obtain the maximum sugar content In this respect the continental farmer is at an advantage in that his crop matures earlier than in England

As regards harvesting implements, the ordinary lifting plough appears to be as suitable as any looseners' employed on the Continent, and the fundamental factor on which economic marketing depends seems to be efficient organisation of harvesting operations, rather than on the introduction of expensive machinery Labour is the chief item in the grower s costs Generally speaking this is both more plentiful and cheaper in Germany and Belgium than in England, a large proportion of the work being done by well organised gangs of labourers which travel round the country If the beet is grown 'in shift', that is, in place of the ordinary root crop such as mangolds, the farmer in England has probably no need to obtain outside labourers, and in this way his costs are kept low On the other hand, his acreage and therefore his returns are also limited, and if at some distance from a factory transport introduces heavy charges Co operation alone provides a solution to these problems

The question of improving the percentage sugar content in the beet is as yet imperfectly understood, but an increase in tonnage lies more in the farmers hands and is certain to bring in a larger return Returns can also be appreciably increased by an intelligent use of by products, in fact the financial success of the beet crop may depend on it The tops as well as the wet or dry pulp available at a low price from the factory, are valuable as cattle food, and the continental farmers invariably make full use of them for this purpose Reduction in factory costs is all important for the success of the industry Heavy expense is incurred owing to the factories lying idle except during a few months in the autumn and winter, and if the extraction process could be continued throughout the year an appreciable reduction in costs could be made A new system is now on trial at the Eynsham factory with the view of achieving this by means of subjecting the beet to a drying process It is claimed that the dried slices or cossettes' can be stored without undergoing deterioration or loss in sugar content but the method has still to be proved before any far reaching claims can be made for it

The future of the industry in England cannot yet be predicted, but there seems no reason why it should not prove successful if every effort is made to reduce costs to a minimum, and to secure the closest co operation between the grower and the factory

Jubilee of the Hellenic Society

ON June 24 the Society for the Promotion of Hellenic Studies will celebrate the fiftieth anniversary of its foundation On the afternoon of that day a commemorative meeting will be held in the Stationers Hall Ave Maria Lane, at 3 P M The chair will be taken by Mr Arthur Hamilton Smith president of the Society, who will deliver his presidential address Prof Gilbert Murray has promised to speak, and addresses and greetings from friendly and allied bodies will be presented In the evening of the same day a festival dinner will take place at the Criterion Restaurant at which Mr A Hamilton Smith will preside The guest of the evening will be Lord D'Abernon who will propose "The Prosperity of the Society", a toast in which he will be supported by Sir James Frazer The reply has appropriately been entrusted to Mr George Macmillan, honorary secretary of the Society from 1879 to 1919, and now honorary treasurer, to whom the Society has been deeply indebted throughout its history for his unceasing activity on its behalf

When the Hellenic Society, as it is familiarly, if incorrectly, called, was founded in 1879, the extent and character of the influence it was to exert in humanistic studies could scarcely have been foreseen Not only was the trend of the political situation at that time obscure, it was also necessary that those who controlled the Society should be at some pains to define its activities in order to remove an impression from the mind of the public to whom it hoped to appeal, that its aims were not exclusively literary Accession to its numbers was rapid and influential At the second annual meeting the council was able to announce a membership of nearly four hundred, while the first page of the original candidates' book reads like a scholars' roll call with such names as Canon Seddon, Dr Donaldson, J R Green J E C Welldon Rev J A Magrath, and Robinson Ellis, to name a few only In regard to the scope of its activities, there is no side of the life and art of ancient Greece on which it has not touched but above all it has earned the undying gratitude of the scholar and historian by the way in which, both as a body and through its individual members, it has fostered research in the prehistory of the Eastern Mediterranean

Within the years of the life of the Society, Sir Arthur Evans, always one of its most prominent members, has revealed an entire civilisation second to none in importance in the history of human culture More directly, perhaps, is gratitude due for the active interest taken by the Society in the foundation of the British School of Archæology in Athens, the practice ground of a distinguished line of British archæologists and scholars The foundation of such a school was the subject of discussion in the council from the early days of the Society This bore fruit in the opening of the School in 1886 Fittingly enough one of the two memorial volumes to be issued in connexion with the anniversary deals with the excavation of the sanctuary of Artemis Orthia at Sparta carried out by the School, and is edited by Prof R M Dawkins, a former director The second volume, by Mr George Macmillan, is a history of the Society

University and Educational Intelligence

CAMBRIDGE —The Ministry of Agriculture and Fisheries has informed the secretary of the School of Agriculture that a grant not exceeding £3000 has been sanctioned by the Empire Marketing Board for the provision of buildings to investigate the use of B C G vaccine in the protection of calves against tuberculosis

Dr Marshall has been reappointed reader in agricultural physiology

Mr F P Ramsey, King's College has been reappointed University lecturer in mathematics

The electors to the Isaac Newton Studentships give notice that an election to a studentship will be held early in the Michaelmas Term 1929 These studentships are for the furtherance of advanced study and research in astronomy

EDINBURGH —Sir Alfred Ewing, who is retiring from the principalship of the University, and Lady Ewing have received warm testimony of the esteem in which they are held in Edinburgh On June 11 a portrait of Sir Alfred was presented to the University and a replica to Lady Ewing at a large gathering of subscribers in the Upper Library Hall The presentations were made by the Lord Provost, and Sir John Gilmour, Lord Rector of the University, accepted one of the portraits on behalf of the University The portraits, by Mr Henry Lintott R S A represent Sir Alfred in his robes as Vice Chancellor On June 14 at a great gathering in the M'Ewan Hall gifts from the students were presented to Sir Alfred and Lady Ewing who, on leaving the hall, were accorded a great demonstration and were drawn in a decorated carriage by way of Princes Street to their house in Moray Place On June 18 the members of Senatus entertained Sir Alfred at dinner in the Senate Hall Lady Ewing has also received a gift from the wives of the members of the staff of the University

The resignations are announced of Dr R Stewart MacDougall, reader in agricultural zoology, who has been responsible for the teaching in agricultural and forest entomology since 1906, and of Dr John Stephenson, lecturer in zoology (invertebrates) since 1920 and formerly professor of zoology and principal of Government College, Lahore

MANCHESTER —The Council has accepted a gift of £1500 from Messrs Benger's Food, Ltd This amount, together with a previous gift of £500 from the same source, is to be devoted to the furnishing and equipment of the new laboratories for pharmacological and pharmaceutical chemistry, which will bear the name of the "Benger Laboratories"

The Grisedale scholarships for biological research previously of £100 each, will in future be combined in one annual scholarship of £200 In the present year two scholarships of £200 will be offered, and application must be made to the Registrar not later than June 22

DR LEWIS F RICHARDSON, who is in charge of the Physics Department, Westminster Training College London, has been appointed Principal of Paisley Technical College

THE Royal Commission for the Exhibition of 1851 has made the following appointments to the five Senior Studentships offered for award in 1929 —On the recommendation of the University of Cambridge Mr F P Bowden (Tasmania), for research in physical chemistry, Mr C S Hanes (Toronto), for research in plant physiology, Mr M L E Oliphant (Adelaide), for research in experimental physics, Mr B Woolf (Cambridge), for research in biochemistry, all at the University of Cambridge On the recommendation of the Imperial College of Science and Technology Dr W F Whittard (London and Cambridge) for research in geology and zoology at the Imperial College of Science and Technology

THE National Congress of Parents and Teachers in the United States, which had in 1928 a membership of 1 279 000, is engaged in a strenuous campaign for promoting child welfare through the stimulation of parental interest and sense of responsibility In the December issue of *School Life* an account is given of one of its activities known as 'the summer round up of the children', the essential features of which are (1) A physical examination on or before May 1 of all children who will be due to enter school for the first time in the following autumn, (2) the application during the summer of appropriate treatment for remediable defects and (3) a second inspection in the autumn to ascertain the extent to which the defects have been corrected The aim of course is to ensure for as many children as possible a fair start on their school career Begun in 1925, this enterprise has been successful whilst maintaining the closest relation and most helpful co operation with the regular health agencies in securing the personal activity of the parents Clearly the parents thus early aroused to the need of preventive and corrective measures are likely to continue to take an intelligent interest in such matters—and this view has been abundantly confirmed An investigation made after the first of these round ups indicated that less than 3 per cent of the children examined were not in need of remedial treatment The campaign has the support and co operation of the United States Bureau of Education the American Medical Association, and other important bodies and numerous doctors dentists, and nurses give their services freely in the examinations

THE Report on the work of the Department of Petroleum Technology of the Sir John Cass Technical Institute for the session 1928–29 has just been issued While differing but little from that of the previous session, in so far as the schedule of work and organisation is concerned it is clear that steady progress is being maintained and that the particular body of men for whom the courses are specially designed namely those engaged in clerical and administrative branches of the industry, is deriving a considerable benefit therefrom The necessity for co operation between industry and educational authorities has been sufficiently voiced ever since the War, in a recently published Board of Trade report, this policy is re-emphasised and each great industry is enjoined to 'make its own educational needs the subject of thorough and systematic examination' While the oil industry as a whole can certainly be acquitted of any charge of neglect on this score the Sir John Cass Institute has gone more than half way in giving practical expression of the desire of the academic world to do its share There can be no possible excuse for any non technically trained man in the industry who desires to widen his knowledge and thus to better himself if he does not take full advantage of such instruction as is here provided The chief subjects covered during the session were general technology of petroleum, chemical and physical properties methods of examination of oils and the applications of engineering It is satisfactory to note that two most important subjects were included in the work of this session 'Developments in Lubrication" and "Geophysical Methods as applied to Oil finding" This in itself is sufficient testimony to the thoroughly modern character of the curriculum and, incidentally, significant of the value attaching to the policy adopted by the Governors for the past eight years, that of keeping in close touch with prominent men in the industry in its several specialised branches

Calendar of Patent Records

June 23, 1789.—General Henry Seymour Conway, nephew of Sir Robert Walpole, and Secretary of State from 1765 until 1768, was granted a patent on June 23, 1789, for utilising the waste heat from coke ovens and conveying it through pipes "for the working of steam engines the baking of bread, meat, or other food, the calcining and fusing of ores and metals, the making of brass and steel, as also for the purpose of warming rooms, staircases, large buildings, and for heating water."

June 24, 1738.—The patent granted to Lewis Paul on June 24 1738, includes the earliest example of cotton spinning by roller drawing, the specification describing a process in which the prepared sliver having been passed through one set of rollers, "a succession of other rowlers, cillinders, or cones, moving proportionately faster than the first, draw the sliver into any degree of fineness which may be required." There is, however, very little evidence to show that this part of the invention was ever put into practical operation, and the main credit for the introduction of roller spinning must be given to Sir Richard Arkwright.

June 24, 1856.—The system of interlocking railway points and signals was the invention of John Saxby, of the L. B. & S. C. R. and was patented by him on June 24, 1856. The advantages of the new system were at once recognised and it was generally adopted. Works were started by Saxby first at Haywards Heath and then in London, and branch factories were opened in Brussels and Paris.

June 25, 1761.—An early attempt at the manufacture of the parts of watches by machinery was made by George Sanderson watchmaker, of Exeter, who was granted a patent for his invention on June 25, 1761. On the same date, June 25, a year later, a second patent was sealed to Sanderson for a "lunar and calendar watch key", in which a calendar mechanism in the key was caused to advance one day by the act of winding the watch. According to Britten, keys on this plan were made by Etienne Tavernier of Paris at the end of the eighteenth century.

June 26, 1799.—The first self acting carding machine for making wire cards for preparing wool and cotton was patented by Amos Whittmore and Clement Sharp of London on June 26, 1799. The machine bent and cut the wires, pricked holes in the leather, and inserted the teeth into the holes by one operation, but the cards produced by it were too coarse to supersede the hand made cards in Great Britain, where the art had been brought to great perfection. The inventors therefore took their machine to America, where it proved very successful owing to the lack there of efficient card makers. Afterwards, the patent was acquired by the American, J. C. Dyer, who so greatly improved the machine that he was able to reintroduce it into Great Britain and to establish a considerable trade. His improved machine was patented in 1811.

June 27, 1838.—The successful production of seamless brass and copper tubing is due to Charles Green, of Birmingham, whose patent for the process was granted on June 27, 1838. The invention, similar to John Wilkinson's earlier process for making lead tubes, consisted in drawing a thick tubular ingot, the internal diameter of which was approximately the same as that required for the finished tube, until it had been reduced to the requisite thickness. The inventor proposed to use on his drawbench four rollers arranged at right angles, the periphery of each being hollowed out so that when brought together a complete circle was formed.

Societies and Academies.

EDINBURGH

Royal Society, June 3.—**W. C. M'Intosh**: On abnormal teeth in some mammals, especially in the rabbit. In the Primates the chief irregularities are the development of extra molars, the narrowing of the tip of the lower jaw so that the incisors and canines are crushed from their normal positions, asymmetry of the muzzle, gaps between the teeth, and bulging of the rows of grinders internally or externally. In the Carnivora, gaps between the incisors in the maxilla and mandible, displacement and duplication of canines and duplication of incisors are found. In forms suffering from peridentitis salivary calculi occasionally occur. Displacement of a canine may be accompanied by an aperture in the hard palate into which the tooth fits. About twenty Rodents other than rabbits have been found with abnormal teeth, amongst which striking cases exist in the beaver, hare, and the brown rat, the right mandibular incisor in the former making more than a circle and penetrating the soft parts. In the teeth of the sperm whale the dentine and cement may be diseased and abraded. The folding of the root of the small tusk of the female dugong is noteworthy. In the Ungulates and marsupials numerous abnormalities present themselves. Special attention was devoted to the rabbit, abnormal teeth in which were described in about 100 cases and grouped temporarily into (1) those with the upper incisors more or less symmetrically curved outward, (2) upper incisors deflected to one side, (3) upper incisors curved into the mouth. The old view of such dental abnormalities being due to external injury must be abandoned, since in every group congenital causes or diseases were usually at the root of the abnormalities.—**Ian Sandeman**: Bands in hydrogen related to the Fulcher system. The $3^3S \rightarrow 2^3S$ system of Richardson and Das is extended, the band previously given as the null band (0, 0) now being taken as (2, 0), while two additional vibrational levels are added on the infra-red side.—**J. A. V. Butler** and **W. O. Kermack**: The action of salts of polynuclear bases on colloidal suspensions and on the electro capillary curve. In small concentrations, salts of 5 : 6 benz 4 carboline and its derivatives effect precipitation of colloidal gum benzoin and other negatively charged lyophobic colloids, but when higher concentrations are used no precipitation occurs and the colloidal particles acquire a positive charge. Experiments on the precipitation of colloidal gum benzoin by mixtures of benz-carboline and gelatin indicate that the presence of the gelatin tends to decrease the adsorption of the benz carboline. Benz carboline sols, present in low concentration ($M/20,000$), exercise a marked effect on the electro capillary curve of mercury, the depression being maximum on the positive side of the maximum of the primary, that is when the mercury is positively charged relative to the solution. The results indicate that benz-carboline ions undergo marked adsorption even on a positively charged surface.—**Sir Thomas Muir**: The theory of skew determinants and pfaffians from 1891 to 1919.

DUBLIN

Royal Irish Academy, June 10.—**R. Lloyd Praeger**: Report from the Fauna and Flora Committee on recent additions to the knowledge of the fauna and flora of Ireland. The report deals with recent progress in our knowledge of a large number of Irish animal and plant groups, and where a previous comprehensive report has been published, it gives a detailed account of all additions.—**R. Lloyd Praeger**

Sempervivа of the Canary Islands area with special reference to hybrids The paper was mainly the results of four months' work in the Canary Islands in 1927, and dealt especially with the occurrence of numerous hybrids among the species of *Sempervivum* which form so marked a feature of the vegetation of that region —**J Kaye Charlesworth** The glacial retreat in Iar Connaught The glaciers of the ice centre of Iar Connaught overrode the western part of the Central Plain of Ireland, and on their retreat deposited the marginal accumulations about Lough Corrib and Lough Mask On the inner side of these moraines there lies a wide zone devoid of moraines This zone is followed by the central area of the submontano and cirque moraines of the local glaciation of Iar Connaught They probably denote a new advance of the ice **J J Drumm, R J P Carolan, and Hugh Ryan** The constitution of iso catechin tetramethyl ether Iso catechin tetramethyl ether was prepared from chloro catechin tetramethyl ether by indirect hydrolysis It consisted of colourless crystals melting at 121° 122° C whereas catechin tetramethyl ether melts at 146° 147° C The preparation of iso catechin tetramethyl ethyl ether and of iso catechin tetramethyl methyl ether are also described Both of these are optically active but differ markedly from catechin tetramethyl ethyl ether and catechin tetramethyl methyl ether respectively in optical activity and melting point The racemic form of iso catechin tetramethyl ether and of iso catechin tetramethyl methyl ether could not be obtained by the reduction of the respective ethoxy and methoxy pyrylium colour bases which latter together with chloro catechin tetramethyl ether were first produced by Drumm (*Proc R I Acad* **36**, B 5 (1923) p 46) The work is in agreement with that of Freudenberg (*Annalen d Chemie*, 1925 446, 87) who has shown that in the preparation of the chloro catechin tetramethyl ether of Drumm (loc cit) a pinacoline transformation takes place involving a wandering of the veratryl group with consequent formation of an $\alpha\beta$ diphenyl propane derivative , catechin itself being an $\alpha\gamma$ diphenyl propane derivative —**J J Drumm, Sheila M Maguire and Hugh Ryan** 3 4 Dimethoxy benzyl 3 5 dimethoxycoumaranone The previous work of Drumm, MacMahon and Ryan (*Proc R I Acad* , **36** B (1924), p 154) had shown that the reduction of veratrylidene 3 5 dimethyoxycoumaranone by means of hydrogen in presence of platinum black gave rise to a dihydro compound, in the formation of which latter compound it was assumed the veratrylidene double bond was reduced, leaving the carbonyl group untouched It is now shown that in the above reduction the carbonyl group is unaffected, for on treatment with phenyl magnesium bromide, a colourless crystalline carbinol is obtained, melting at 82° 83° C This carbinol on bromination in the ordinary way yields a monobromo derivative melting at 115° C

Paris

Academy of Sciences, May 13 —Guido Ascoli The approximate representation of functions —**J Delsarte** The Fredholm transformations rendering invariant a quadratic functional —**Coulomb** A formula of quantic algebra —**Fahir Emir** A new determination of the thickness of a film of oleic acid in the state of saturation on water and of the saturation pressure of this film The experimental results given agree well with those of Marcelin as regards the thickness of the saturated film, but the figures for the saturation pressure are definitely lower The causes of the difference are discussed The film has the same thickness on distilled water and on weak ($N/20$) hydrochloric acid —**Pierre Auger** The theory of the photo electric effect The formula recently deduced by A Sommerfeld gives a distribution formula in good agreement with experiment —**Mme and M Lemarchands** The constant of equilibrium in double decompositions in aqueous solution A study of the reversible reaction $BaSO_4 + 2HCl = H_2SO_4 + BaCl_2$ From the equilibrium constants at 18° C and 100° C and the application of the van t Hoff equation, a figure for the heat of reaction is found which agrees within the limits of experimental error with the direct thermochemical determination —**H Colin and A Chaudun** The concentration of the sugar and velocity of hydrolysis in acid solution —**Mlle Suzanne Veil** The ferromagnetic properties of the ferrites —**Ch Bedel** Some conditions of solubility of silicon in hydrofluoric acid Hydrofluoric acid in the presence of oxidising agents (potassium permanganate chromic acid ferric chloride hydrogen peroxide) dissolves silicon readily The nature of the metal forming the containing vessel also exerts an influence on the rate of solubility **Swigel Posternak and Théodore Posternak** The configuration of inactive inosite —**Georges Mignonac and Odd W Rambeck** The action of cyanogen chloride, bromide and iodide on the sodium compound of ethyl malonate The syntheses of ethano tetracarboxylic acid and ethylene tetracarboxylic acid The cyanogen halides do not react similarly Sodium ethyl malonate in ether solution gives mainly ethylmalonic ether with cyanogen chloride replacement of the latter by cyanogen bromide gives a mixture of the ethyl ethers of ethylene tetracarboxylic acid and ethane tetracarboxylic acid The latter substance is the sole product when cyanogen iodide is used **Mme Ramart-Lucas and F Salmon-Legagneur** The comparative stability of isomers from their absorption spectra (Dehydration of glycols isomerisation of ethylene oxides)—**L Royer** The corrosion of a crystal of dolomite by an active isotropic liquid A comparison of the corrosion figures of dolomite produced by active and by inactive organic acids shows that the result is affected by both the optical symmetry of the crystal and by that of the acid **Jean Chevrier** The daily variation of the electrical potential of the air and of electrical loss during the month of September 1928 at the Observatory of Ksara (Liban) —**Paul Becquerel** The latent life of pollen grains in a vacuum at −271° C Pollen grains (*Antirrhinum Nicotiana*) after drying over caustic baryta were placed in a tube from which the air was removed as completely as possible with a Langmuir condensation pump and then sealed up The tubes were placed in liquid helium (temperature −269 to −271 7C) for seven hours and kept for five months The germinating power remained unaltered by this treatment, although similar grains preserved in dry air for seven months lost their germinating power —**Raymond-Hamet** Pharmacological applications of the technique of the kidney transported to the neck —**René Fabre and Henri Simonnet** The physical and biological study of the dextrorotatory sterol isolated from beer yeast The slight curative effect (anti rachitic) observed with irradiated zymosterol is regarded as probably due to traces of ergosterol left in the product in spite of careful purification —**Edouard Chatton and Mme M Chatton** The conditions of conjugation of *Glaucoma scintillans* in lethobacterial cultures The direct and specific action of certain zygogen agents —**H Pénau and G Tanret** A dextrorotatory sterol of yeast, zymosterol Details of the method of preparation from yeast, purification, analysis, physical and chemical properties The alcohol is not simply isomeric with ergosterol as it contains two hydroxyl groups and has the formula $C_{27}H_{40}(OH)_2$ —**H Jacotot** The preparation of a

hyperactive serum against cattle pest —**V Zernoff** An attempt at serotherapy in *Galleria melonella* The injection of the blood of vaccinated larvæ produces a curative effect, and this curative property of the blood of vaccinated larvæ may be preserved for several days *in vitro*

Rome

Royal National Academy of the Lincei, Mar 3 —**G Fubini** The canonical pencil —**G Armellini** The horizontal diameter of the sun in 1927 and 1928 Measurements of the horizontal diameter of the sun during its passage of the meridian, made at the Campidoglio Observatory by various observers, give the following mean values for the past few years 1924, 16′ 1 03″, 1925, 16′ 0 63″, 1926, 16′ 1 02″, 1927, 16′ 1 54″, 1928, 16′ 1 58″ —**A Comessatti** Galois' curves (2) —**G Scorza-Dragoni** Integrals of the equation, $y'=f(x, y)$ —**G Krall** Local limitations of dynamic effort —**A Wundheiler** A generalised displacement in Riemannian spaces In a paper published last year, Gerhard Thomsen described applications of a new notion of parallelism in Riemannian spaces, termed the Fermi parallelism The latter is defined by certain properties, which lead to a formula worked out by Thomsen in the particular case when the displaced vector is orthogonal to the curve of transport In the present paper the general formula for this displacement is derived —**G Vitali** The centres of curvature of the geodetics of a variety It is shown that, if P is a point of a variety V_n of n dimensions, in which the σ_2 of V_n has $n+\nu$, $\nu=(n+1)/2$ dimensions, the centres of curvature in P of the ∞^{n-1} geodetics of V_n issuing from P are situate on a hyper sphere K passing through P of the linear space S_ν of ν dimensions lying in σ_2 and perpendicular to Vn —**F Lamberti** Two particular dynamic equations of a linked material system —**Gabriella Armellini Conti** Colorimetric observations made during the total eclipse of the sun on June 29, 1927 A series of photographs, taken at Ringebu (Norway), of a polychrome screen exposed to the sun's light confirm the red coloration of the light apparent during the eclipse —**L Martinozzi** The electrical characteristics of meteorites (the hypothesis of an electrical origin of their luminosity) and a limiting value for the density of the ions in the upper atmosphere Burgatti (1927) has advanced the view that the luminosity of meteorites may be of electrical origin A simple calculation, made on the basis of certain assumptions, of the electrical charge necessary to a meteorite in order that bombardment of the ions present in the zones traversed may render it luminous, leads to somewhat high values for this charge and hence for the corresponding potential Taking into account the fact that the charge should be negative, the values found are not easily explained, since, as Burgatti pointed out it would be more reasonable to expect that meteorites would become positively charged by photoelectric action, nothing is, however, known concerning the distribution of potential in the universe The necessary value calculated for the number of ions per c c agrees well with the number required for Heaviside's reflecting layer —**E Amaldi** and **E Segrè** The theory of the Raman effect The mechanism of the Raman effect proposed by Smekal and generally accepted would indicate that Raman lines corresponding with very intense infra red bands should be also very intense Observations have failed to confirm the existence of any such relationship, and it is now shown that the experimental results are in complete accord with the theories of Schrödinger and Dirac, and that with any Raman line there corresponds, not necessarily an infra red absorption band, but simply the difference between two terms, only when, by chance, such two terms combine directly will an infra red line exist —**L Fernandes** Investigations on sulpho salts (8) Persulpho salts —**G Malquori** The system $Fe(NO_3)_3-KNO_3-HNO_3-H_2O$ at 25° —**F de Carli** The double carbonate of cobalt and potassium The double salt, $CoCO_3, K_2CO_3, 4H_2O$, may be completely dehydrated by heating it at 120° in a current of carbon dioxide Measurement of the dissociation tension at various temperatures, and application of Nernst's approximate formula, give for the heat evolution corresponding with the equation, $Co+1\frac{1}{2}O_2+C=CoCO_3$, the value 169 43 or 163 13 Cal, according as the heat of formation of CoO is taken as 63 80 or 57 59 Cal Calorimetric determination gives the value 173 31 Cal —**A Pieroni** Naphthophenoxanthones $\alpha\beta$ Naphthophenoxanthone cannot be obtained by the general reactions serving for the preparation of the $\beta\beta$ and $\beta\alpha$ isomerides, possibly owing to the ready elimination of the carboxyl in the α position of the naphthalene nucleus, but is formed when α benzoyl β naphthol is heated with aluminium chloride for 2 hours at 150°, it crystallises in golden yellow needles melting at 173°, and its solution in sulphuric acid is yellow and shows an intense green fluorescence —**T G Levi** 1 3 5 Dithioazine (formothialdine) This, the first member of the thialdine series, has not previously been described It may be obtained, together with trithioformaldehyde, by treating aqueous formaldehyde solution with sulphur or, better, ammonium hydrogen sulphide —**Giulia Martinez** Heulandite from Monastir —**R Grandori** Symbiotic micro organisms in the egg of *Pieris brassicæ L*

Vienna

Academy of Sciences, Feb 28 —**A Haas** Stefan's law and the theory of light quanta The number of light quanta emitted is proportional to the third power of the temperature, whilst the average energy of the single light quantum is proportional to the temperature itself —**R Bortsch** The determination of stresses in discs with arbitrary boundaries —**A Dadieu** and **K W F Kohlrausch** Studies on the Raman effect (1) The Raman spectrum of organic substances (fatty acids and their esters) —**R Weiss** and **A Kratz** A new synthesis of cumarine derivatives (2)

Mar 7 —**A Kailan** and **A Schachner** The velocity of esterification of fatty acids with ethylene glycolic hydrochloric acid —**W J Müller** The theory of passivity phenomena (5) The influence of covering films on the potential of a metal —**G Koller**, **H Ruppersberg**, and **E Strang** The condensation of *o* amino benzaldehyde with keto dicarbonic acid esters and di keto carbonic acid esters —**R Dworzak** and **K Hermann** Cyclic acetals (2) —**W Schmidt** The structure of the wind To obtain the simultaneous wind velocities at a series of adjacent points a new method of observation was worked out Light pressure plates in great numbers were brought together and photographed kinematographically The experiment was made on an area of 10 × 10 metres —**F Hölzl** The alkylisation of tri- and tetra cyano cadmic acids —**K Funke** and **H Wolf** Researches on perylene and its derivatives (23rd communication) —**A Pongratz** 24th communication —**A Zinke** and **W Hirsch** 25th communication

Mar 14 —**W J Müller** and **K Konopicky** The anodic behaviour of aluminium An inquiry arising out of the surface passivity of aluminium —**R Wegscheider** The photochemical transformation of *o* nitro benzaldehyde —**E Späth** and **N Polgar** The

quaternary bases in *Berberis vulgaris* Besides berberin there is also palmatin, iatrorrhizin, columbamin, and berberrubin —E Späth and G Papaionou Phenol bases in the bark of Angostura, synthesis of galipolin —R Dworzak and J Pierri Studies on *a* bromo and oxy aldehyde —C Doelter Blue rock salt —F Hochstetter Contributions to the developmental history of the human brain K Fritsch Observations on flower visiting insects in Styria, 1909 *Helleborus niger* had many visitants on sunny days in its natural localities, *Prunus avium* was visited by *Macroglossa fuciformis* Other observations supplementary to Knuth's work G Ortner Measurement of strong polonium preparations by means of the charge transported by the emitted *a* particles —F Hölzl, Th Meier-Mohar, and F Viditz Alk oxonium hexa cyano cobaltates —K Menger (1) A partition theorem for rational and irrational dimensional assemblages (2) The nowhere dense partial assemblages of *Rn* (3) Deducing the concept of dimension from postulates —E Deussen The composition of iron fluoride

Official Publications Received

BRITISH

Malayan Forest Records No 6 Mangrove Forests of the Malay Peninsula By J G Watson Pp viii+275 (Kuala Lumpur F M S Conservator of Forests) 3 dollars 7s

Commonwealth of Australia Second Annual Report of the Council for Scientific and Industrial Research for the Year ended 30th June 1928 Pp 38 (Canberra F C T H J Green) 1s 8d

Memoirs of the Punjab Irrigation Research Laboratory Vol 1 No 2 A Statistical Examination of the Sensitivity of a Water Table to Rainfall and Irrigation By Bernard Howell Wilsdon with R Partha Sarathy Pp 24 (Lahore Government Printing Office) 1 rupee 1s 6d

Report of the Botanical Survey of India for 1927 28 Pp 8 (Calcutta)

Tanganyika Territory Report of the Department of Agriculture for the Year ending 31st March 1928 Pp 57 (Dar es Salaam) 2 6d

Miscellaneous Publications of the Royal Alfred Observatory No 7 The Cyclone Season 1927-1928 at Mauritius By R. A Watson Pp 4+47 charts (Mauritius)

The Research Association of British Paint Colour and Varnish Manufacturers Technical Paper No 1 Tung Oil a Review of the Possibilities of Production within the British Empire with a Complete Bibliography of the Literature relating to Tung Oil from 1917-1927 excluding Patents By Dr L A. Jordan Pp 40 (Teddington)

Journal of the Marine Biological Association of the United Kingdom New Series, Vol 16 No 1 May Pp 363 (Plymouth) 12s 6d net

Journal of the Royal Statistical Society New Series Vol 92 Part 2 Pp 163 321+xii (London) 7s 6d

Transactions of the Optical Society Vol 30 No 3 1928 29 Pp iv+101 140 (London) 10s

Seale Hayne Agricultural College, Newton Abbot Devon Department of Plant Pathology Fifth Annual Report for the Year ending September 30th, 1928 (Pamphlet No 30) Pp 40 (Newton Abbot.)

Annals of the Natal Museum Edited by Dr Ernest Warren Vol 6 Part 2, May Pp 171 336+plates 12 22 19s net. Vol 5 Index Pp v+449 458 (London Adlard and Son Ltd)

Falmouth Observatory Report of the Joint Observatory Committee to the Royal Cornwall Polytechnic Society and the Falmouth Town Council for the Year 1928 Pp. 5 Meteorological Notes and Tables for the Year 1928 also Table of the Mean Magnetic Declination at Falmouth from 1888 to 1928 By W Tregoning Hooper Pp 7 (Falmouth)

Air Ministry Aeronautical Research Committee Reports and Memoranda. No. 1208 (Ae 309) A Dash Pot for use in Spinning Experiments on a Model Aerofoil By T H Fewster (T 2691) Pp 2+1 plate. 4d net. No 1209 (Ae 362) Wool Tufts a Direct Method of discriminating between Steady and Turbulent Airflow over the Wing Surfaces of Aircraft in Flight applied to explore the Region of Effect of the Slot on a Bristol Fighter Wing By Flight-Lieut J A G Haslam (S. and C 273) Pp 6 4d. net. No 1214 (Ae 373) On a Method of delaying the Opening of an Autoslot (Wind Tunnel Experiments) By F B Bradfield and R A. Fairthorne (T 2719) Pp 6+4 plates 6d net. No 1212 (Ae 371) Preliminary Tests on the Effect on the Lift of a Wing of the Position of the Airscrews relative to it. By F B Bradfield (T 2716.) Pp 10+4 plates 9d net. (London H M Stationery Office)

Harper Adams Agricultural College, Newport Salop Some Cattle Diseases—Contagious Abortion Tuberculosis Mastitis (Garget) Report of Conference held at the College on Tuesday, April 9th. Pp 24. (Newport, Salop)

Gold Coast Survey Tables for use in the Department Pp 46+2 plates (Accra.)

Journal of the Chemical Society containing Papers communicated to the Society May Pp iv+858 1111+x (London)

Proceedings of the National Laboratory of Psychical Research Vol 1, Part 2: Short-Title Catalogue of Works on Psychical Research Spiritualism, Magic, Psychology, Legerdemain and other Methods of Deception, Charlatanism, Witchcraft and Technical Works for the Scientific Investigation of alleged Abnormal Phenomena from Circa 1450 A.D to 1929 A.D Compiled by Harry Price Pp 65-422+32 plates. (London.) 15s. net.

The National Benzole Association Sixth Report of the Joint Benzole Research Committee of the National Benzole Association and the University of Leeds Pp ii+21 (London)

Proceedings of the Geologists Association Edited by A K Wells Vol 40 Part 1 May 22 Pp 104 (London Edward Stanford Ltd) 5s

The Royal Society for the Protection of Birds Thirty eighth Annual Report January 1st to December 31st 1928 with Proceedings of Annual Meeting 1929 Pp 108 (London) 1s

The National Physical Laboratory Inspection by the General Board June 18th 1929 Pp 15 (Teddington)

Rothamsted Experimental Station Harpenden Investigations in Progress in the Laboratories and Experimental Fields 1929 30 Pp 12 (Harpenden)

Empire Cotton Growing Corporation Report of the Administrative Council of the Corporation to be submitted at the Eighth Annual General Meeting on June 3rd 1929 Pp 55 (London)

Report of the Astronomer Royal to the Board of Visitors of the Royal Observatory Greenwich read at the Annual Visitation of the Royal Observatory 1929 June 1 Pp 17 (Greenwich)

South Australia Empire Forestry Conference 1928 Forestry Handbook Prepared by E Julius and A J Pinches Pp 146 (Adelaide Harrison Weir)

The Indian Forest Records Silviculture Series Vol 13 Part 8 Volume and Outturn Tables for Blue Pine (*Pinus excelsa* Wall) By H G Champion Ishwar Das Mahendru and Parma Nand Suri Pp iv+41 (Calcutta Government of India Central Publication Branch) 1 2 rupees 2s

Department of Education National Library of Ireland List of Scientific and Technical Periodicals in Dublin Libraries Pp vi+147 (Dublin Stationery Office) 5s net

Proceedings of the Royal Society Series A Vol 124 No A 794 June 4 Pp 243 477 (London Harrison and Sons Ltd) 8s

Philosophical Transactions of the Royal Society of London Series A Vol 228 A 663 A Photographic Investigation of Flame Movements in Carbonic Oxide Oxygen Explosions By Prof William A Bone and Reginald P Fraser Pp 1 7 44+11 plates (London Harrison and Sons Ltd)

The Strangeways Research Laboratory formerly the Cambridge Research Hospital Pp 10 (Cambridge)

Transactions and Proceedings of the New Zealand Institute Vol Part 4 December 1928 Pp iv+663 1024+xii (Wellington N Z)

The Indian Forest Records Silviculture Series Vol 14 Part 2 Denudation of the Punjab Hills By B O Coventry Pp v+30+7 plates (Calcutta Government of India Central Publication Branch) 1 4 rupees 2s 3d

Journal of the Indian Institute of Science Vol 1 A Part 7 Studies on Soil Actinomycetes I Introduction by V Subrahmanyan and Roland V Norris II Their Mode of Occurrence in the Soil by V Subrahmanyan Pp 53 68 (Bangalore) 1 rupee

Commonwealth of Australia Council for Scientific and Industrial Research Pamphlet No 11 The Tasmanian Grass Grub (*Oncopera intricata* Walker) a Preliminary Report on its Life History and Method of Control By Gerald F Hill Pp 43 (plates) (Melbourne H J Green)

South Australia Department of Mines Mining Review for the Half Year ended December 31st 1928 (No 49) Pp 63+8 plates (Adelaide Harrison Weir)

FOREIGN

Reprint and Circular Series of the National Research Council No 87 Final Report of the Committee on Scientific Problems of Human Migration Pp 21 (Washington D C National Academy of Sciences) 30 cents

The Danish *Dana* Expeditions 1920 22 in the North Atlantic and the Gulf of Panama Oceanographical Reports edited by the *Dana* Committee No The Fishes of the Families Astronesthidae and Chauliodontidae By C Tate Regan and Ethelwynn Trewavas Pp 39+7 plates (Copenhagen Gyldendalske Boghandel London Wheldon and Wesley Ltd) 10s

Mellon Institute of Industrial Research Bibliographic Series Second Supplement to Bulletin No 2 A List of the Books Bulletins Journal Contributions and Patents by Members of the Mellon Institute of Industrial Research during the Calendar Year 1928 By Lois Heaton Pp 11 (Pittsburgh Pa)

Sudan Government Wellcome Tropical Research Laboratories Khartoum Report of the Government Chemist for the Year 1928 (Chemical Section Publication No 59) Pp iv+39 (Khartoum)

Agricultural Experiment Station Michigan State College of Agriculture and Applied Science Technical Bulletin No 96 A Local Farm Real Estate Price Index By F M Thrun Pp 81 Special Bulletin No 180 The Soils of Michigan Grayling Sand By M M McCool and A G Weidemann Pp 24 Special Bulletin No 185 Roadside Marketing in Michigan By H I Gaston Pp. 40 Special Bulletin No 188 Pollination of Orchard Fruits in Michigan By Roy E Marshall Stanley Johnston H D Hootman and H M Wells Pp 38 Special Bulletin No 189 The Marketing of Michigan Milk through Creameries Cream Stations Condenseries and Cheese Factories By F T Riddell and I T Horner Pp 36 (East Lansing Mich)

Classified List of Publications of the Carnegie Institution of Washington Pp 202 (Washington D C Carnegie Institution)

Carnegie Institution of Washington Fourteenth Issue Pp 63 (Washington D C Carnegie Institution)

Proceedings of the United States National Museum Vol 74 Art 6 Notes on some Oriental Sapromyzid Flies (Diptera) with particular reference to the Philippine Species By J R Malloch (No 2751) Pp. 97+6 plates. Vol 74 Art 7 A Revision of the Wood Warbler Genus Basileuterus and its Allies By W E Clyde Todd (No 2752) Pp 95. Vol 75, Art. 11 A Contribution to our Knowledge of the Anatomy of the Fresh water Mussels of the District of Columbia By Lucy Reardon (No 2782) Pp 12+3 plates (Washington D C Government Printing Office)

Annuaire de l Académie Royale des Sciences des Lettres et des Beaux Arts de Belgique, 1929 95e année Pp. 155+4 planches (Bruxelles Maurice Lamartin.)

Annuaire de l'Observatoire Royal de Belgique 97e année 1930 Pp. 100 (Uccle)

Annales de l'Observatoire Royale de Belgique Troisième série Tome 2 Fascicule 2 Catalogue de 419 étoiles de comparaison pour la planète Eros à son opposition de 1930-1931 Par F Moreau G Becq T de Clerck et F Verbaandert Pp 77 102 (Uccle)

Journal de la Société des Américanistes de Paris Nouvelle série Tome 20 Pp xxvii+589 (Paris)

Ministère de l'Instruction publique et des Beaux arts Enquêtes et documents relatifs à l'enseignement supérieur 123 Rapports sur les Observatoires astronomiques de Province et les Observatoires et Instituts de Physique du Globe Année 1927 Pp 108 (Paris)

Publications of the Far Eastern State University Serie 7 No 12 Adsorption as a general Characteristic of Coal and Peat the Condition of Genesis Occurrence Gas Contents Superficial Alteration, Spontaneous Combustion Coke Formation and Hydrogenation By Prof B I Lentegoff Pp 82 In Russian with Summary in English (Vladivostok) 50 kop

Report of the National Research Council for the Year July 1 1927–June 30 1928 Pp iii+95 (Washington D C Government Printing Office)

Department of Commerce Bureau of Standards Research Paper No 64 Prism Refractometry and certain Goniometrical Requirements for Precision By I W Tilton Pp 909 930 10 cents Research Paper No 65 A new Determination of the Melting Point of Palladium By C O Fairchild W H Hoover and M F Peters Pp 931 962 10 cents (Washington D C Government Printing Office)

Department of Commerce Bureau of Standards Visitors Manual of the National Bureau of Standards a Brief Account of its History Functions and Laboratory Facilities (Miscellaneous Publication No 93) Pp ii+19 (Washington D C Government Printing Office)

Publikationer og mindre Meddelelser fra Københavns Observatorium Nr 61 Asymptotische Lösungen im restringierten Dreikörperproblem (Problème Restreint) Von Elis Strömgren Pp 5+1 Tafel (København)

Bulletin of the American Museum of Natural History Vol 58 Art. 7 The Adaptive Modifications of the Arboreal Tadpoles of *Hoplophryne* and the Torrent Tadpoles of *Staurois* By G K Noble Pp 291 334+plates 1 10 (New York City)

United States Department of Agriculture Technical Bulletin No 111 Fish Oil as an Adhesive in Lead Arsenate Sprays By Clifford E Hood Pp 28 (Washington D C Government Printing Office) 10 cents

Japanese Journal of Geology and Geography Transactions and Abstracts Vol 6 Nos 3 4 Pp iii + 83 147 + 9 20 + 7 + plates 11 27 (Tokyo National Research Council of Japan)

Proceedings of the United States National Museum Vol 75 Art 16 A newly found Meteoric Stone reported by W B Lang from Peck s Spring Midland County Texas By George P Merrill with Chemical Analysis by E A Gonyer (No 2787) Pp 2+1 plate Vol 75 Art 17 A new Nematode *Sincosta aberrans* new Genus and new Species from a Rodent By Glenwood C Roe (No 2788) Pp 3+1 plate (Washington D C Government Printing Office)

Sveriges Geologiska Undersökning Ser Ca No 18 Nordmarks Malmtrakt Geologisk beskrivning Av Nils H Magnusson Summary The Iron and Manganese Ores of the Nordmark District Pp 98 (Stockholm) 7 00 kr

Publications de l'Observatoire de Genève Rapport sur les concours de réglage de chronomètres de l'année 1928 Pp 31 (Genève)

Treasury Department United States Public Health Service Studies on Oxidation Reduction 13 Preparation of Indophenols which may be used as Oxidation Reduction Indicators By H D Gibbs, W L Hall and W M Clark (Supplement No 69 to the Public Health Reports) Pp. iii+35 10 cents 14 Equilibrium Potentials of 2 6 Dibromo benzenone Indophenol 2' Sodium Sulphonate 2 6 Dibromobenzenone Indophenol 3 Sodium Sulphonate 2 6-Dichlorobenzenone Indo 2' Chloro phenol and 2 6 Dimethylbenzenone Indophenol By Wallace L. Hall Paul W Preisler and Barnett Cohen (Supplement No 71 to the Public Health Reports) Pp iii+28 10 cents (Washington D C Government Printing Office)

CATALOGUES.

A Catalogue of Important and Rare Books on Botany, Agriculture Forestry Fruit Culture Gardens and Gardening Herbals Early and Modern Medicine and Surgery Tobacco (No 426) Pp 142 (London Bernard Quaritch Ltd)

Art and Literature including a selection from the Library of Sir Edmund Gosse (No 446) Pp. 20 (Cambridge Bowes and Bowes)

Botany and Horticulture (Catalogue No 109) Pp 56 (London Dulau and Co Ltd)

Diary of Societies

FRIDAY JUNE 21

ROYAL SOCIETY OF MEDICINE (Otology Section) (at Cambridge) at 2 — L Yates The Evolution of the Sense of Hearing —J S Tucker Localisation of Sound —S. Hett Dr A G Wells, and Dr Murray Levick Ionisation as a Treatment for Middle ear Suppuration —At 4 30 —Dr A. A. Gray The Application of the Principles of Maximum Stimulation to Clinical Otology —G Wilkinson Demonstration of a Model Resonator, Designed to Illustrate the Mechanism of the Cochlea.

ROYAL SANITARY INSTITUTE (at North East Coast Exhibition Newcastle upon Tyne), at 2.30.—Dr H G Davison and others Discussion on The Problem of Feeding the Premature Infant —Dr E F Murray and others Discussion on The Need for a Maternity Service —Dr H. H Evers and others Discussion on The Importance of Ante-Natal Supervision —At 4 30.—D Boyd and others Discussion on Eliminating the Tuberculous Cow Administrative Results at Berwick upon Tweed — D W Henderson and others Discussion on Hygienic Milk Supplies —C H Westwater and others Discussion on Clean Milk in the Northern Counties —At 8.—Prof L E Hill Smoke Pollution (Public Lecture).

ROYAL SOCIETY OF MEDICINE (Obstetrics Section), at 8 —G F Gibberd The Use of Animal Bladders for the Induction of Premature Labour — Prof Cleland and Drs Dawson Wallace and Hackett Difficult Labour in Australian Aboriginal with Post-mortem Measurements of the Pelvis —C D Read and F Roques Some Results of the Surgical Treatment of Pelvic Endometriomata

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (Annual General Meeting) (at 11 Chandos Street W), at 8 15 —Induction of New President, Dr G Carmichael Low —Dr J F C Haslam Some Health Problems of British Guiana.—Presentation of the Manson Medal to Sir Ronald Ross and the Chalmers Medal to Major A. C Sinton

ASSOCIATION OF ECONOMIC BIOLOGISTS (Annual Field Meeting) (at Cambridge) (continued on June 22).

SATURDAY JUNE 22

ROYAL SOCIETY OF MEDICINE (Otology Section) (at Cambridge) at 9 30 A M —M Vlasto The Chorda Tympani Nerve in Otology —C S Hallpike Some Observations on Bone Conduction —A R. Tweedie Demonstration of Apparatus for Control of Conversation Test

ROYAL SOCIETY OF MEDICINE (Disease in Children Section) (at Nottingham) at 3

PHYSIOLOGICAL SOCIETY (at Plymouth)

MONDAY JUNE 24

ROYAL GEOGRAPHICAL SOCIETY (Anniversary Meeting) (at Æolian Hall), at 3 —Presidential Address Annual Report and Presentation of Medals etc

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8 30 Presentation of Royal Gold Medal

TUESDAY JUNE 25

ROYAL DUBLIN SOCIETY at 4 15 —Report of the Irish Radium Committee for the Year 1928 —H A Cummins Violet C E Kennelly and M Grimes A Study of Fungi found in Milk —P A Murphy Some Insect Vectors of Virus Diseases in Plants.—L P W Renouf A Hydrographical and Biological Study of Lough Hyne Co Cork — J Reilly (a) An Investigation of the Polysaccharides Part I Inulin (b) The Cryoscopic Constants of Acetamide —P H J Poole A Suggested New Type of Sensitive Suspended Needle Galvanometer

ROYAL ANTHROPOLOGICAL INSTITUTE at 8 30 —Miss Beatrice Blackwood The Indians of British Columbia.

INSTITUTION OF MECHANICAL ENGINEERS (at Manchester) (continued on June 26 28).

WEDNESDAY JUNE 26

ROYAL SOCIETY OF ARTS at 4 — Annual General Meeting

EUGENICS SOCIETY (at Royal Society) at 5 15 —Dr M C Buer Health and Prosperity in the Early Nineteenth Century

GEOLOGICAL SOCIETY OF LONDON at 5 30 —R. O Roberts The Geology of the District around Abbey Cwmhir (Radnorshire).—Dr C A Matley and Dr A Heard The Geology of the Country around Bodfean (South Western Carnarvonshire).—Dr G H Mitchell The Petrography of the Borrowdale Series of the Kentmere Area (Westmorland).

THURSDAY, JUNE 27

ROYAL SOCIETY at 4 30 —Lord Rayleigh A Photoelectric Method of Measuring the Light of the Night Sky with Studies of the Course of Variation through the Night.—Prof J C McLennan, M W Perrin and H J C Ireton The Action of High Speed Cathode Rays on Acetylene —T E Stern B S Gossling, and R H Fowler Further Studies in the Emission of Electrons from Cold Metals —And other Papers

ROYAL SOCIETY OF MEDICINE (Urology Section), at 8 30

FRIDAY, JUNE 28

PHYSICAL SOCIETY (at Imperial College of Science), at 4 45 —Dr Teresa J Dillon The Relation between Hydrogen Pressure and Filament Resistance in a Tube containing Glowing Tungsten —Dr Frances Lowater The Band Systems of Titanium Oxide —F E Smith The Absolute Measurement of Sound Intensity —A Demonstration of an Apparatus for the Measurement of Electrical Resistance at High Temperatures will be given by Dr J L Haughton

FRIDAY, JULY 5

GEOLOGISTS ASSOCIATION (in Architectural Theatre, University College, Gower Street) at 7 30 —Christopher T A Gaster Chalk Zones in the Neighbourhood of Shoreham Brighton, and Newhaven, Sussex —H G Smith Some Features of Lamprophyres, near Sedbergh, Yorkshire

PUBLIC LECTURE

WEDNESDAY, JUNE 26

UNIVERSITY OF BIRMINGHAM, at 4 30 —Dr C Singer The Modern Spirit in Medicine (II).

CONFERENCE

JUNE 24 TO 27

BRITISH PHARMACEUTICAL CONFERENCE (in Dublin).

Monday, June 24, at 8 P M —Reception at the Mansion House

Tuesday, June 25, at 10 A.M —Chairman s Address. Reading of Science Papers

At 2 15 —Delegates Meeting

Wednesday June 26, at 10 A.M —Science Meeting

At 11 A.M —Delegates Meeting.

At 2 30.—Science Meeting

Thursday, June 27, at 10 A.M —Closing Session

SATURDAY, JUNE 29, 1929

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The New Museum Outlook

THE museums of Great Britain are bestirring themselves, or, if that be putting it too strongly, at any rate many men of action and foresight are bestirring themselves concerning the museums There is a museum feeling in the air But in the midst of the reports and commissions, addresses and discussions which express this activity, the plain man may be excused if he fails to see that criticisms, suggestions and counter suggestions all point to a broad but tolerably well defined road by which the museums of the British Isles must endeavour to make their way The new road is the focus of many independent paths along which progressive museums have been feeling their way in recent years, often in face of difficulties, and scarcely realising that they were *taking part in one of the great educational* movements of the times Though the reports have scarcely emphasised the magnitude of the change, it means a radical recasting of the museum idea and the adoption of a fresh museum outlook

Here we propose to outline the fundamental change in outlook which progress demands and to inquire whether recognition of the new objective may lead to suggestions for the development and control of existing museums

In their historical origin, museums were simply conservatories, in the basic meaning of the word, houses for the storing and safe keeping of whatever was thought to be worth keeping, and their officers were and are keepers That is still looked upon as the primary and fundamental purpose of museums, and yet it is only in a few of the largest museums that the material is of a value so great or nature so irreplaceable that its conservation is of first and last importance In the second stage of their development, museums condescended to show some of their possessions to favoured visitors and finally to the public, but they placed the specimens just as they were accustomed to store them, in the arrangement most convenient for reference by experts It is not so many years since a keeper in one of the national museums gave instructions that *British birds (and that in a British museum) should* be labelled with their Latin scientific names only The attitude, and it was widespread, was that the public might learn if it could, but it was no purpose of the museum to teach

That almost all the natural history collections in the museums which possess them are still arranged on the systematic lines of the expert taxonomist, is a relic of an early development, a convenient grouping for reference, easy for the museum officer

to arrange, and capable of infinite expansion Educationally, however, it is a passive arrangement It permits the visitor, if he is receptive, to gain certain impressions of form and of relationship, but it is not designed to thrust new ideas upon him, to compel him to consider and reconsider In a general way that is typical of the old museum attitude to education , hitherto the museum has been an inactive educator, allowing the visitor to sip where he would, or go away dry if the nectar was not to his taste, but never, by one wile or another, compelling him to drink of the stimulating cocktails it might concoct

The new outlook which underlies the recent discussions regarding the museums of Great Britain, and towards which a few bright exceptions have been striving is that museums must henceforward make it a primary duty to take an active and progressive part in the educational systems of the country In a short preface to an American work dealing with the relationship between the American Museum of Natural History and the Educational authority of New York,[1] Prof Henry Fairfield Osborn stated that the growing museum influence, which during the past quarter of a century has been especially remarkable throughout the cities of the United States, is largely due to the recognition that the museum is not a conservative but a progressive educational force, that it has a teaching quality or value peculiar to itself, that the museum succeeds if it teaches, fails partially if it merely amuses or interests people, and fails entirely if it simply mystifies

If only this could be set as an aim and end in the forefront of museum activities, the museums of Great Britain would take on a fresh lease of activity, and create for themselves a new and powerful place among the social institutions of the country, in no less degree than they have done in the United States of America

In an address delivered a short time ago to the Royal Society of Arts and referred to in NATURE (Feb 9, p 227), Sir Henry Miers sketched in broad outline the ways in which museum collections might be brought into relationship with educational stages He founded his proposals on the assumption that museums should cater for four classes of visitors For the ordinary visitor the history and resources of the town or district should be displayed , school children and students of riper years require summary collections and introductory series , for the collector and serious inquirer systematic collections are needful , and the researcher must have at hand great stores of classified material for investigation and comparison

Even this passive arrangement of museum exhibits falls short, however, of the needs of an active educational policy, such as the times demand, and such as has been attained by many of the museums in the United States As typical of these, glance at the activities, almost violent activities our sedate institutions would regard them, of the museums of the Brooklyn Institute of Arts and Sciences In the course of a single year ten special exhibitions of various art collections and eight exhibitions of prints were arranged and exhibitions of motion pictures portraying the Chronicles of America ' and zoological subjects, as well as lecture courses for the public, for teachers and for students were held In addition the Institute has specialised in a Children s Museum ', with loan exhibits of natural history specimens for schools, with schools visits helped by three teachers assigned by the Board of Education, summer field trips, lectures, and so on The detail with which the educational side is organised is indicated by many little refinements, such as the small cases of mounted birds which a child may borrow and take home as he would a book, the files of five thousand pictures and of trustworthy magazine articles, so catalogued that any set may be selected and borrowed by child or teacher, and the loan series of eight thousand lantern slides

Is it desirable that the museums of Great Britain should reach towards such a goal? And if it is, is such a goal attainable ? The consensus of opinion amongst educationists, the efforts already being made by the more progressive museums in this country, and the views expressed in or underlying recent reports and discussions, all point to the desirability of some such development, if museums are to escape from the backwash of stagnation and move with the main stream of the nation's progress It may be said that the proper purpose of the great national museums is rather to attend to scientific interests than to cater for the education of elementary school children, but the argument is sufficiently met by the actual development of the American institutions, which have satisfied the demand for intrusion into educational affairs without losing a whit of their scientific enthusiasm or reputation

The question as to whether this desirable end is attainable is not so easily answered Our opinion, however, is that it can be realised, but not under museum conditions as they generally exist in Great

[1] Free Nature Education by the American Museum of Natural History in Co-operation with the Department of Education of the City of New York , by G H Sherwood 1920

Britain to day An analysis of the difficulties will suggest lines along which development might well take place

There is the fundamental difficulty of staffing The teaching of young and old is an art based upon scientific principles, definitely recognised and the subject of specialised courses in universities and training colleges It cannot be expected that the curators of museums, whether they be chosen for their general knowledge or for their expert skill in particular branches of science, can be at the same time, barring a few exceptional cases, in close touch with educational developments and the needs of elementary, secondary, and advanced education Even if they knew the demands, they cannot be expected to be familiar with the technique and progress of modern educational methods

It is evident, therefore, that a scientific museum staff is not best fitted for the carrying out of an educational policy, quite apart from the fact that in the larger museums the scientific staff is already overburdened with its own particular problems If the museum share in educational progress is to be more than a mere nibbling at the fringe of a great problem, new qualifications and new personnel must be drafted into the scheme Moreover, this change must take place with as little disturbance of existing arrangements as possible, for it is recognised that, for the purposes which they now serve, the greater museums are working competently and smoothly There must be no uprooting of a well-established growth, the educational shoot must be grafted upon the present sturdy museum plant

These considerations suggest one or two broad lines of change which might well herald the adoption of an active educational policy There must be a mutual approach between the museum body and the educational body This *rapprochement* would develop in two directions, one affecting the framing of general museum policy and the other the actual development of the policies decided upon In the first case, the governing body of the museum, whether it be an *ad hoc* committee of the county or municipality, the council of a naturalist society, or an advisory body of whatever origin, would be strengthened and broadened in outlook by the inclusion of one or more of the leading educationists of the district, selected for their capacity in dealing with new problems as well as for their knowledge of educational needs It would be strange indeed if, on such a body, discussions between men of general culture, educational specialists, and representatives of the museums themselves did not evolve new suggestions worthy and capable of being carried out

The carrying out of the schemes so formed leads to our second consideration On one hand museum staffs must co operate with educational authorities, and on the other, educational authorities must make more use of museums On the lowest scale, this implies that exhibits of museum materials will be arranged in such a way that they can be used, simply and easily, to illustrate the Nature study lessons of the schools, and that school authorities will support the effort by making full use of the museum But on a higher scale, and in the large museums, it would imply much more, as the activities of the Brooklyn Museum foreshadow The large museum would play its part by appointing a staff specifically to deal with educational activities, the educational authorities would detail certain of their teachers to conduct school parties in the museum, give museum lessons, and so on

In whatever way it may be accomplished and whatever degree of development it may reach, the closer association between museums and formal education is an end eagerly to be desired, it would inevitably lead to fresh lines of usefulness for museums already flourishing, and might spell a new life for many institutions now all but moribund The passive, dead and alive museum is like a bank which, having collected the moneys of its customers, exhibits a few samples of currency in its windows and locks the remainder in its strongholds It is not the receipt and storing of money or of specimens, but the use made of them, that means success for bank or museum That is, in effect, our plea for the deliberate adoption, in museums large and small throughout Great Britain, of the new museum outlook

Mathematical Physics

Mathematical and Physical Papers By Sir Joseph Larmor In 2 volumes Vol 1 Pp xii + 679 Vol 2 Pp xxxii + 831 (Cambridge At the University Press, 1929) £6, 6s net

THESE volumes contain the contributions made by the author to different scientific societies and periodicals during a period of nearly half a century, and the subjects treated of extend to almost every branch of physical science The author observes in his preface that "every investigator bears the stamp of the domicile in which he has been brought up" In the present case there are two domiciles, to the first is probably traceable the influences of Hamilton and MacCullagh The

second, beginning at Cambridge towards the end of the period which saw the rediscovery of Green's work, the publication of Thomson and Tait's "Natural Philosophy", and the publication of Maxwell's treatise on "Electricity and Magnetism", has also had its influence, both in the selection of the subjects of investigation and on the method of treatment

One of the outstanding events of the period was the recognition of the importance of the Lagrangian method as the means of investigating not only the problems of mechanics but also the problems of physical science in general The memoir by Green on the reflection and refraction of light is possibly the earliest in which the conditions for the successful application of the method to a physical problem are set out clearly, although not infrequently too much trust has been placed in his statement—"that but little effort is required on our part"—while the caution implied in the earlier part of the passage quoted from is overlooked

By 1880 the value of the method in the investigation of the problems had been fully recognised, and had become the usual method of investigation for these problems The method naturally plays an important part in the present collection In the paper "On Least Action as the Fundamental Formulation in Dynamics and Physics" (*Proc Lond Math Soc*, 1884) the method is applied with success to a great variety of problems both in mechanics and physics and the mathematical connexion between them is established The same method is applied to the problem of "the flow of electricity in a system of linear conductors", leading to a very general solution of the problem In the first 400 pages of the first volume there are papers on subjects in pure mathematics, optics, and electricity of varying length and importance, but all of interest The British Association Report (1893) on 'The Action of Magnetism on Light, with a Critical Correlation of the Various Theories of Light Propagation" gives an account of the different theories which had been proposed to account for the phenomena accompanying the propagation of light up to the time of its preparation, and compares them carefully, at the same time making various suggestions and removing some of their obscurities This report is the forerunner of the series of three papers "On a Dynamical Theory of the Electric and Luminiferous Medium" published in the *Philosophical Transactions*

The first of these papers appeared in 1893, and its central feature is the identification of the electric energy function with the energy function developed by MacCullagh in relation to optical phenomena This energy function had been arrived at by adopting a procedure which was the converse of the procedure adopted by his predecessors

The elastic solid theory of light propagation as developed by Green, Cauchy, and others had provided an adequate representation of the phenomena of the reflection and transmission of light in the case of isotropic media but had failed to give results which were in agreement with Fresnel's results in the case of anisotropic media Green and Cauchy had proposed to overcome this difficulty by the introduction of extraneous forces MacCullagh set out to discover the energy function which would satisfy Fresnel's laws both for isotropic and anisotropic media Later, Kelvin showed that the energy function built up by MacCullagh was that of a quasi labile elastic medium or of a gyrostatically loaded medium, hypotheses which are not unrelated to the hypotheses of Green and Cauchy In the author's paper of 1893, this energy function having been identified with the electric energy function is applied and tested for a great number of different phenomena In particular the result is obtained that the velocity of propagation of light is affected by a magnetic field Experiments carried out by Sir Oliver Lodge showed that the effect, if any, is so small as to be incapable of detection Two conclusions can be arrived at as the result of these experiments, either the luminiferous medium is fixed or stagnant, or the energy function which leads to this result is defective The author has chosen the first of these alternatives, but it may be observed that the direct application of Faraday's laws to the problem of the effect of a constant magnetic field on the velocity of the propagation of light gives the same result as these experiments, namely, that there is no effect

The problems of magneto optic rotation and radiation are discussed on this theory, and with the introduction of a dissipation function, the circumstances of the reflection of light by metallic media are investigated

In an appendix the theory of electrons is introduced and applied to some of the cases, in particular, the theory of natural magnets is treated from this point of view, and also optical dispersion In the second paper (1895) the theory of electrons is developed to a greater extent, and is applied to the investigation of the phenomena which depend on the molecular or atomic properties of material media In addition to the phenomena discussed in the first paper, the propagation of light in metals, conduction currents, the mechanical electro-dynamic

forces acting on a conductor the problems of a conductor rotating in a symmetrical magnetic field and the conjugate problem of a rotating electrified conductor are considered as also the pressure of radiation The null result of the Michelson Morley experiment is discussed on this theory and explained in terms of what is now usually referred to as the Lorentz transformation

In his memoir La théorie électromagnétique de Maxwell et son application aux corps mouvants (1892) and in a later memoir (1895) H A Lorentz developed a theory of electrical and optical phenomena similar to the theory presented in the present volumes The energy function which is fundamental in both cases is the same and although the treatment more especially where statistical processes are involved is somewhat different the results obtained when the phenomena discussed are identical are naturally for the most part in agreement The particular form of the transformation arrived at in the case of a material body moving with a uniform velocity from which the later development known as the theory of relativity has arisen is an inevitable consequence of the form of the energy function which is the basis of the theory of a stagnant ether but there are difficulties connected with this theory which so far do not appear to have been surmounted For example is the Lagrangian method applicable to the comparison of two systems when the space co ordinates of the one involve the time co ordinate of the other and the time co ordinate of the first involves the space co ordinates of the second? Furthermore it has been proved that if Faraday s laws are applied to the case of a material body moving with a uniform velocity the axes of reference for Faraday s laws being the same as the axes of reference for the moving body the relation between the moving body and a body at rest relatively to the same axes is that the moving body is contracted in the ratio $(1-u^2/c^2)^{\frac{1}{2}}$ in the direction of its motion and no transformation involving the time co ordinate is involved

In the third paper of the series the theory of electrons is restated and its application to material media is more extensively developed The investigations of the two previous papers are revised in some cases the relation of the theory to the kinetic theory of gases and to radiation is investigated a general theory of optical dispersion is set out and the problem presented by absorption bands is discussed Thermodynamics osmotic pressure the laws of chemical equilibrium para magnetism and diamagnetism are also discussed and the mechanical relations of radiation are re investigated

Whatever the ultimate verdict on this theory of the ether which is the basis of these papers (afterwards with additions and revisions embodied in the author s Æther and Matter) may be it offered a possible and promising line of advance it is in agreement with a greater number of physical phenomena than its predecessor the elastic solid theory of the ether and the author s contributions to it are very notable There are subsequent papers on other applications of the theory the Zeeman effect the optical influence of a magnetic field etc all additions of interest to the subject

There are several papers on geophysics an interesting paper on Huygens principle various reports and addresses but probably the most important papers in the collection other than the electrical papers are the papers on thermodynamics and the theory of gases The author has expressed a doubt as to whether the time is ripe for the formulation of a history of electrical theories this despite the many treatises on thermodynamics and the kinetic theory of gases is true in some measure of the theories connected with these latter subjects These volumes however contain valuable contributions in this direction and in a connected form would go far to supply such a history

A detailed examination of the different papers in the two volumes is impossible within the present limits but it may be observed that they contain contributions of interest and value to most of the questions which have been prominent in physical science for the last half century By collecting them together so as to make them readily accessible to other scientific workers the author has earned their gratitude and the care with which they have been edited and printed reflects great credit on the author and on the Cambridge University Press

One Hundred Years of the 'Zoo

Centenary History of the Zoological Society of London By P Chalmers Mitchell Pp xi + 307 + 33 plates + 9 plans (London Zoological Society of London 1929) 25s

BY its Zoo is the Zoological Society of London known to the people its zoological gardens have given it a hold upon the nation which no purely scientific activity could have gained and the progress of the Zoo is the touchstone by which its success will be tested at any rate by the superficial Yet from the outset of its career two distinct and almost antagonistic aims lay at the hearts of

the founders of the Zoological Society and were embodied in its charter on one hand the popular appeal of the introduction of new and curious subjects of the Animal Kingdom and on the other the sternly scientific advancement of Zoology and Animal Physiology It is perhaps the greatest triumph of its hundred years of existence that the Society has cherished these two objects with equal favour developing its gardens to their utmost limits and at the same time making vast contributions to the progress of knowledge It has done more it has blended a double function which might have split the Society to its roots into a harmonious whole so that the Zoo has become the patron of science contributing handsomely to its coffers and science the handmaiden of the Zoo has eased the conditions of its inmates and furthered their welfare in the details which make life in captivity worth living

In his Centenary History Sir Peter Chalmers Mitchell traces with easy knowledge the multifarious lines of activity which have coalesced to make the Zoological Society and its Zoo what they have become The Society owes its origin in 1826 to Sir Stamford Raffles who lived just long enough to see it well on its way to success Its earliest stages were recently discussed in an article in NATURE (May 4 p 687) so that no further reference to its foundation need be made except that it is desirable to point out that following Scherren s The Zoological Society of London (1905) undue weight was there placed upon the part taken by the Zoological Club of the Linnean Society Chalmers Mitchell has investigated this and many other controversial points with minutest care and the pains which he has evidently bestowed upon the consultation of original sources of information ensure that his is the last word in these matters

Since the Zoo is the hub of the system let us glance at the major developments which have kept it in the centre of public favour The chart which forms a frontispiece to the volume and in itself is a mine of information shows plainly that an unprogressive policy is reflected in stationary or dwindling audiences The fresh appeal of the original gardens soon wrought itself out and was followed by a steady decline in numbers of fellows in numbers of visitors and in income which must have caused deep concern to those in authority Now a glance at the series of plans of the gardens at different stages of development appended to the volume shows that since the first concession of twenty acres in 1826 there has been a gradual extension of area to more than double the original size But the chart reveals no connexion between increasing prosperity and mere accretion of acres On the other hand it clearly demonstrates that the secret of success from the public point of view is the staging of special features which not only attract a temporary fresh influx of visitors but tend to raise subsequent attendances to a new base level

Accidental influences such as the Great Exhibition of 1851 or the International Exhibition of 1862 are naturally enough reflected in the numbers of visitors to the Gardens but the lesson of the chart is that special efforts at display meet a rich reward Royal collections of animals since that first exhibited by the Prince of Wales in 1876 have always been exceedingly popular but the organised works which have brought overwhelming success are the Mappin Terraces in 1913 the Aquarium in 1924 the Reptile House in 1927 and the Bird House in 1928 Taking the appointment of the present secretary in 1903 as a convenient datum line it is a remarkable testimony to his progressive policy that in the quarter of a century which has since elapsed the number of fellows has more than doubled annual income has trebled and the number of annual visitors has increased almost fivefold

Keeping step with these popular developments have been no less important changes which appeal perhaps more strongly to the scientific observer notably the vital innovation from the stuffiness of closed and warmed cages to natural temperatures and open air the introduction on a large scale of radiant heat for the animals and a great step in progress the acquisition of Whipsnade Park and the planning there of scenic panoramas and paddocks on the most advanced lines

Of the purely scientific activities of the Society we have left ourselves no space for comment The *Proceedings* and *Transactions* which are stocked with results based largely upon the collections themselves are as indispensable to the scientific worker as is the Zoological Record and the one time museum notable for the large proportion of type and historic specimens which it contained on its dispersal enriched the Natural History Museum at South Kensington and to a lesser extent other institutions

The century not without its dissensions and difficulties has been one on which the Zoological Society and the nation can look back with pride and from which they can look forward with confidence in a strong guidance enlightened by scientific knowledge and enriched by the naturalists wide sympathy with living things J R

Alpine Tectonics

The Nappe Theory in the Alps (Alpine Tectonics, 1905–1928) By Prof Dr Franz Heritsch Translated by Prof P G H Boswell (Methuen's Geological Series) Pp xxx + 228 + 8 plates (London Methuen and Co , Ltd , 1929) 14s net

THE existence of great overthrusts in the Alps was recognised by Escher von der Linth in 1853, and by von Richthofen in 1859, and was proved from the mining at Idria by Lipold in 1874 , but it was only after the work of Schardt in 1894 that these displacements were generally accepted and explained as nappes Nappe is the French word for a sheet, but the term is used in Alpine geology, as in the title of this book, as an abbreviation for a *pli nappe* or *nappe de recouvrement*, or over folded sheet Such nappes are explained as due to flat lying folds from which, as they are pushed forward, the central limb is ground to powder and worn away According to the advocates of the theory, the nappes in the Alps cause horizontal displacements that are well established for 60 miles, while the total movement may be much greater , for some of the mountains seen from the terrace at Berne are regarded as parts of Africa pushed into central Switzerland

The difficulty of the subject to British students is increased by its scattered literature and special technical terminology The book by Prof Heritsch of Graz, therefore, should prove of great service, as a guide to the modern literature on the Alps, especially on the Eastern Alps, and as a statement of the evidence for and against the nappe theory The work has been extended and revised by help of the author during the translation, which in several respects is an improvement on the original It has additional illustrations, and the excellent glossary which has been prepared by the translator will, it may be hoped, standardise the English equivalents of many of the tectonic terms

The attractiveness of the nappe theory depended upon its seductive simplicity The alternative explanations are often complex When, however, the theory is followed into details, the simplicity disappears owing to rapid changes in the hypothesis, extreme differences of opinion among its supporters, its evasiveness of crucial tests, and fantastic explanations introduced to explain special cases The theory is often dependent upon uncertain identifications of the age of the rocks For example, the Matterhorn consists of a pyramid of gneiss resting on schists which are regarded as altered Trias If this age of the basal schists is incorrect, the upper part of the Matterhorn need not be explained as a far travelled erratic Similarly with the Hohe Tauern in the Eastern Alps the nappe theory there depends on the identification of part of the schists as Trias, but if they are pre Cambrian the application of the theory to the Tauern is invalid

The difficulties of rock identification are met by the assumption that the differences between various parts of the same sheet are due to differences of facies For example, the rocks identified as the southern root of the Silvretta nappe form the hills east of the northern end of Lake Como These rocks are so different from those of the Silvretta as to suggest doubt as to their belonging to one sheet This difficulty is circumvented by the assumption that the differences are due to the rocks having been deposited so far apart that they occur in different facies This facies argument, as remarked by Prof Boswell in the preface, is naturally regarded with suspicion by British geologists, who are used to the rapid lithological changes among our Jurassic deposits The extreme movements claimed have not been supported by the discovery in the Alps of the characteristic North African facies of the Eocene or Cretaceous

The nappe theory is faced by serious physiographic difficulties According to some estimates, the nappe movements in the Miocene and Pliocene must have piled up rocks to a thickness of about 20 miles above the Alps All this material must have been since removed by denudation, and there is no trace of the debris on an adequate scale in the surrounding areas Another physiographic difficulty, to which attention was directed by Prof Bailey Willis in 1912, is that there are in the Alps old land surfaces that date from the Lower Miocene and even earlier, and their existence, Prof Heritsch remarks, is quite irreconcilable with the supposed later nappe movements Such difficulties have been often ignored by the supporters of the nappes, who, in their enthusiasm, regard the evidence in favour of the theory as so convincing that they are confident that explanations of these difficulties will appear

The special merit of Prof Heritsch's book is that it states the issues impartially, and by directing attention to the difficulties and uncertainties in the nappe theory, should guide the discussion to the critical points, and thus help in the solution of the problem The book is not easy reading, owing to its conciseness and brief statement of views of bewildering variety It should, however, prove indispensable to students of mountain structure as a guide to current Alpine literature and opinion

Our Bookshelf.

An Introduction to the Study of Ore Deposits By Dr F H Hatch Pp 117 (London George Allen and Unwin, Ltd , 1929) 7*s* 6*d* net

MOST books devoted to the study of ore deposits suffer from an attempt to give too much detail It is manifestly impossible to write an account of the mining fields of the world in small compass and Dr Hatch has not attempted this He has set himself the ideal of producing a real introduction to the subject elucidating everywhere the general principles by illustrations taken from actual instances, and it must be said that in this he has been extremely successful Many of the examples are naturally chosen from his own experiences in different parts of the world, and the outcome is an admirable instance of the application of scientific ideas to a truly practical subject

The first chapter is an interesting historical summary of theories of ore genesis, largely based on the author s presidential address to the Institution of Mining and Metallurgy in 1912, but brought well up to date The next nine chapters are concerned with the different processes of ore formation and alteration the last named being of course a matter of the greatest practical import, in such matters as zones of oxidation and of secondary enrichment Chap ix deals with the origin of residual deposits of all kinds including the laterite bauxite group and manganese deposits, as well as residual ore bearing gravels It is pointed out that in the tropics so called alluvial propositions are often in reality rock in place, so deeply decomposed as to be workable by hydraulic methods The last chapter deals with the forms of ore bodies, and there are no less than four indexes, of authors, localities minerals, and a general index of subjects

This book may be strongly recommended as being what it was intended to be—a real and valuable introduction to the study of mining geology R H R

Denkschriften der Schweizerischen Naturforschenden Gesellschaft (*Mémoires de la Société Helvétique des Sciences Naturelles*) Band 64, Abh 2 *Nouveau catalogue des moules d'échinides fossiles du Musée d'Histoire naturelle de Neuchâtel* Exécuté sous la direction de L Agassiz et E Desor par J Lambert et A Jeannet Pp ii + 83 233 + 2 planches (Zürich Gebrüder Fretz A -G , 1928)

ABOUT 1838, Louis Agassiz had assembled in Neuchâtel specimens of fossil sea urchins borrowed from various public and private collections to aid him in his Monographies d'échinodermes" Many of these specimens became the types of his new species , all were authenticated , and he conceived the happy idea of making plaster moulds from them and of distributing the casts to museums or students interested in the subject After Agassiz left Neuchâtel, the good work was continued by E Desor and later by H Michelin, down to about 1858, when the number of species thus represented amounted to 960 A second edition of the casts was begun in 1854 by L Coulon, who had succeeded to the direction of the Neuchâtel Museum It is to be feared that after a time in many museums these valuable documents of research, having become dusty, lost the respect of a new generation of curators and were not kept in order Even at Neuchâtel itself, the present director 'found the casts piled up at random in two large boxes and sometimes spoiled "

Such being the state of things all serious students of the Echinoidea should be most grateful to Messrs J Lambert and A Jeannet for an extremely careful inquiry into the history of the series, the provenance and ultimate location of the originals the distribution and fate of the casts, and above all for the annotated list of the species represented In this list each entry gives the name under which the cast was issued the subsequent nomenclature of the species, the horizon and locality of the original, with references to descriptions and figures of the specimen In short, nothing seems missing from this *apparatus criticus* F A B

Three Lectures on Neurobiotaxis and other Subjects, delivered at the University of Copenhagen By C U Ariëns Kappers Pp 76 (London William Heinemann (Medical Books), Ltd , 1928) 7*s* 6*d* net

THE Lancashire Asylums Board was recently assured by its officers that persons equipped for neurological research would not now be forthcoming in England, even were money available to employ them If this extravagant statement must be set aside as merely an item in official conversations , it is unfortunately true that Great Britain has now fallen far behind its continental neighbours and America in this direction It is therefore to be hoped that these lectures will have a wide circulation among British readers, in whom neurological interest may thereby be reawakened

The theory which Dr Ariëns Kappers develops in the first of the lectures was first advanced by him more than twenty years ago, and has suffered misunderstanding in Great Britain owing to confusion with the chemotaxic explanation of nerve development proposed by Ramón y Cajal Thus, even so acute a critic as Elliot Smith has put forward Kappers's own principle—one of relative growth at critical moments of development—while implicitly rejecting the theory as unnecessary (Cunningham's " Textbook of Anatomy ")

The present lucid treatment lays stress on simultaneity of function as the essential principle underlying anatomical correlations in the nervous system, and extends the theory to cover a variety of freshly observed instances, particularly some of the baffling phenomena of the decussation of fibre-tracts It is possible to appreciate the far-reaching and illuminating character of the principle of neurobiotaxis without, however, endowing it with causal significance as Dr Ariëns Kappers does on p 36 The last of the three lectures is a brilliant account of the development of the cerebral cortex in terms of neurobiotaxis

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications]*

Solutions and Heat Engines

MAY I add a word to the discussion on osmotics ? As regards the osmotic pressures of mixed gases I would point out that the reviewer s case (2) (NATURE, April 13, p 569), where two atmospheres of nitrogen are inside the chamber and one atmosphere of hydrogen is on each side, is not in osmotic equilibrium if there be any interaction between the molecules of nitrogen and hydrogen the equilibrium will obtain, so it seems to me only when the partial pressure of the hydrogen equals its pressure outside, and we have, as yet, no means of calculating this effect

With liquid solutions a little consideration will convince one that there are a multitude of formulæ, functions of the concentration, which will fit the facts for dilute solutions Among these may I direct attention to one which seems promising ?

If the observations of Berkeley, Hartley, and Burton (*Phil Trans R S*, vol 218) on the osmotic pressures of cane sugar and α methyl glucoside are tabulated, as below, against the weight concentration multiplied by the density of the solution, squared, the figures agree to about 5 per cent

CANE SUGAR								
	At 0° C				At 30° C			
c_2/c_1	O P	Ratio of O P s	d^2	Ratio of $d^2 \times c_2/c_1$	O P	Ratio of O P s	d^2	Ratio of $d^2 \times c_2/c_1$
	Atm				Atm			
0 3400					26 82	1	1 216	1
0 5650	43 91	1	1 357	1	47 25	1 76	1 333	1 83
0 8120	67 43	1 54	1 468	1 56	72 59	2 71	1 439	2 82
1 1200	100 58	2 29	1 580	2 30	107 55	4 01	1 548	4 18
1 4100	134 86	3 07	1 667	3 08	143 33	5 34	1 632	5 56
1 8300	186 86	4 26	1 768	4 21	198 89	7 42	1 730	7 64
2 1750	230 70	5 25	1 835	5 20	249 16	9 29	1 796	9 47
2 4300	264 46	6 02	1 877	5 93				
α METHYL GLUCOSIDE								
	Atm				Atm			
0 3500	48 29	1	1 199	1	49 42	1	1 179	1
0 4500	64 22	1 33	1 245	1 34	65 14	1 32	1 222	1 34
0 5500	80 50	1 67	1 287	1 68	81 73	1 65	1 262	1 68
0 6400	96 17	1 99	1 310	1 90	96 75	1 96	1 294	2 01
0 7500	115 74	2 40	1 361	2 44	115 34	2 33	1 331	2 42
0 9000	142 46	2 95	1 408	3 00	141 66	2 87	1 375	3 00
1 0500	170 18	3 52	1 451	3 60	168 34	3 41	1 415	3 60

NOTES —c_2 and c_1 are the concentrations *i e* number of grams per gram of solution *d* is the density of the solution compressed to its osmotic pressure

It is easy to see that the osmotic pressures must be a function of the density, for consider two cylinders containing different solutions and furnished at the bottom with semi permeable membranes which just touch the surface of the solvent If we neglect the stratification caused by the gravitational field, then, when there is equilibrium across the membrane, $P = hd$ where P is the osmotic pressure, d the density of the solution, and h its height, hence

$$\frac{P_1}{P_2} = \frac{h_1 d_1}{h_2 d_2}$$

An explanation of the weight concentration part of the formula can be put forward. Assume that the solute takes no part in the bombardment of the membrane, that is, this bombardment is conditioned only by the solvent molecules It will be necessary, therefore, to put a pressure on the solution to increase the speed of the solvent molecules such that the number striking the membrane per second on the solution side will be equal to the number on the pure solvent side It is easy to see, if our solution is an ideal one (that is, there is no interaction between the two sets of molecules and therefore there is no change in volume when the *liquid* substances are mixed) that this pressure will be proportional to c_2 and if we remember we are dealing with a *defect* in bombardment, it will roughly be inversely proportional to c_1 The *c* s are the number of grams of solute (c_2) and solvent (c_1) in one gram of solution—and c_2/c_1 = weight concentration/100

Obviously this explanation is but a rough approximation to actual conditions, but if the formula applies to substances other than the sugar type of molecule, we have a rule of thumb means of calculating both osmotic pressures—a matter of some importance as they are just as much physical constants as the density or refractive index

A little thought will make it evident, if we remember that we are still considering an ideal solution, that we could have put $c_2/c_1 = v_2/v_1$ (where v_2 and v_1 are the volumes of the respective components in 1 c c of solution), and we should have had a more consistent formula But with the *v* s[1] of the actual solutions the results are not so good—they only agree to 15 per cent, this is not to be wondered at, for we have not taken into consideration the molecular interaction nor the effect due to closeness of packing I think, however, that these two considerations can be allowed for if we may assume that when one molecule strikes another the rebound is not instantaneous and a 'rest period' ensues the effect of closeness of packing may turn out to be a function of the density, but I have not the means at hand for calculating this I hope to return to the matter in another communication

BERKELEY

[1] These are derived from Porter's (*Proc Roy Soc*, 1908, p 480) definition of his s_1 and s_2

Determination of Crystal Potentials by Diffraction of High Voltage Electrons

WHEN electrons are diffracted by a crystal cleavage face, Bragg's law, on taking account of the refractive index of the crystal for the electron waves, becomes $n\lambda = 2d \sin\theta\sqrt{1 + \frac{\mu^2 - 1}{\sin^2\theta}}$, or, putting $\mu = \sqrt{1 + \frac{\phi}{V}}$ and $\lambda = \frac{h}{mv} = \sqrt{\frac{150}{V}}$ A, where ϕ is the inner potential of the crystal and V is the energy of the electrons in volts, we obtain

$$\sqrt{V}\sin\theta = \frac{n\sqrt{150}}{2d}\sqrt{1 - \frac{4d^2\phi}{150n^2}} \qquad (1)$$

For a spacing 4 A the first order will thus disappear entirely for ϕ as small as 2 4 volts, whatever the value of V This wide variation from Bragg's simple law, then, will be quite as marked for high as for low voltages, and since swift electrons are less liable to be deviated by stray fields, etc, the high voltage method ought to be the more suitable for determining ϕ The surprisingly large effect of refractive index at these high voltages depends on the very small angles of refraction which occur, and is only strongly marked when the reflecting plane is the free surface of the crystal This effect has been pointed out by Prof G P Thomson (*Phil Mag*, 6, p 939, 1928)

Strong spots were obtained on a photographic plate by diffraction from the cleavage faces of calcite (1, 0, 0), galena (1, 0, 0), and antimony (1, 1, 1) For each spot the product $\sqrt{V} \sin \theta$ was constant within the limits of experimental error for the range 10 to 45 kv, but spacings calculated for $\phi = 0$ differed widely from X ray determinations

In the case of calcite there were two spots on the equator line Photographs were taken of each, a willemite screen being used in setting the crystal at the correct angle Substituting the values of $\sqrt{V} \sin \theta$ in equation (1) and taking the spots to be the nth and $(n+1)$th orders, we get two equations to determine n and ϕ These give $n - 3$ and $\phi = 22$ volts, and for this value of ϕ the first and second orders disappear

Galena gave one spot on the equator and two other spots vertically above and below it, that is, parallel to the axis of rotation, which was a cube edge The latter spots were too near the equator line to be due to reflection from any of the geometrically possible planes of the crystal if refraction took place at the (1, 0, 0) plane Good agreement was obtained however, by supposing the crystal surface to be rough and refraction to take place at the plane producing reflection This being the case, the spot on the equator line had to be taken as (6, 0, 0) and the spots above and below it as (6, 0, 2) with ϕ equal to 18 2 volts The plates also showed faint vertical lines at positions corresponding to (8, 0, 0) and (10, 0, 0) for the above value of ϕ The accompanying reproduction (Fig 1) is a galena photograph showing the equatorial spot and the fainter spots vertically above and below it The part of a circle on the extreme right is where the scattered electrons are cut off by the camera

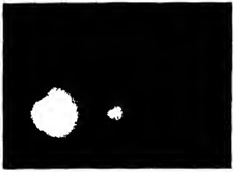

Fig 1

The pattern from antimony was similar to that of galena but less well marked, the spots above and below the equatorial spot being too faint to measure For the spot on the equator line n was so chosen that the corresponding value of ϕ made the $(n-1)$th order disappear, whence $n = 4$, $\phi = 25$ volts

In the calcite photographs, but not in those of antimony and galena, in addition to the spots there were a number of crossing lines, which were obviously similar to those obtained by Kikuchi (*Proc Imp Acad Jap*, **4**, p 475, 1928)

No great accuracy is claimed for the above results, the experiments being of a preliminary nature, but the rapid variation of $\sqrt{V} \sin \theta$ with ϕ indicates that the method may be of importance for precise measurements of the inner potential of crystals

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Luminous Discharge in Gases at Low Pressures

If the Lecher circuit previously employed for generating a luminous discharge in electrodeless tubes by electric oscillations of high frequency—20,000 kilocycles or more—(Nature, **123**, p 346, 1929), is exchanged for short coils, the luminosity can be much increased By the same means it is possible to make the discharge pass through narrow quartz capillaries less than a millimetre in width, thus realising a source of light which has the linear shape suitable for spectrography, and moreover requires a very minute quantity of the gas to be examined

With a plate current of, say, 50 milliamperes at an anode potential of 1000 volts, the light emitted from nitrogen or from the oxides of carbon under these conditions is so intense, that an exposure of thirty minutes or even less suffices for giving with a large quartz spectrograph a fully developed band spectrum in the ultra violet With the inert gases the luminosity is very intense, especially with neon, which gas can be excited to give light of an intensity almost insupportable to the eye both in narrow capillaries and also in wider tubes introduced within the coil through which the discharge is passing Experiments which have still to be carried out will show whether krypton excited by this means in electrodeless tubes will be suitable as a source of the line at 5649 A, recently proposed for a new standard of wave length

Carbon monoxide and dioxide both show a rapid dissociation when subject to the oscillatory discharge Probably for this reason my attempts to separate their spectra by the flow method have so far failed Carbon monoxide excited when passing through a narrow capillary at a velocity of 5 metres per second gives a deposit of carbon, which in the course of a few minutes obscures the light and finally intercepts the discharge Hydrocarbons from tap grease, if once happening to be present within the tube while the discharge is passing, also give a carbon deposit, which no subsequent baking out of the tube in a high vacuum will remove, only burning out by protracted discharge with air or oxygen within the tube If the discharge is made to pass through a tube contaminated in this manner at a low pressure, the oxygen produced from the disintegration of silica is largely converted into oxides of carbon which emit the white light erroneously ascribed to ozonised oxygen in my previous communication (loc cit)

In my spectrograms from the oxides of carbon excited in this manner, all the Deslandres bands belonging to the first negative carbon spectrum falling between 2300 A and 2900 A, as measured by R C Johnson (*Proc Roy Soc*, London, A, **108**, p 343, 1925) have been identified, and an additional number of fainter bands of similar structure The double bands near 2896 A and 2883 A show conspicuous variations in intensity on different spectrograms, which lends support to the view that their origin is different from that of the other bands of the series, which have also a different structure Compare the work of Fox, Duffendack, and Baker (*Proc Nat Academy*, Washington, **13**, p 302, 1925), who have found these two double bands to be due to carbon dioxide

The red fluorescence from quartz or glass excited by the oscillation I now find to have been previously noticed by Wood and Loomis (Nature, **120**, p 510, 1927) and also by McCallum (*ibid*, **121**, p 353, 1928), whose communications had escaped my notice The view of the first named authors that this fluorescence is in some way due to excited molecules or ions of oxygen is no doubt correct, as can be beautifully demonstrated by deflecting with a strong horse-shoe

magnet the egg shaped luminosity of greenish yellow colour which is formed between the electrodes in a discharge tube of wider diameter containing pure oxygen at low pressure At the points where the de flected egg is brought near to the wall, two patches of brilliant red appear, separated by narrow, dark inter spaces from the rim of gold coloured fluorescence next to the electrodes With other gases quartz fluoresces in the deep blue or violet, sometimes in the green, whereas the red fluorescence, corresponding to a band near 620 $\mu\mu$, is only observed with oxygen at low pressure

HANS PETTERSSON

Structure of the Band Spectra of the Hydrogen and Helium Molecules

IN the spectrum of the hydrogen molecule many regularities have been found recently, especially by Richardson and his co workers In a note in the *Zs f Physik* I suggested an interpretation of those regularities based mainly on the theory of band complexes and the analogy with the helium band spectrum The analogy was incomplete in so far as the bands found in the spectrum of the hydrogen molecules are analogous to helium bands which can be predicted from theoretical considerations, but which had not been actually found I have found these missing helium bands now Their structure is exactly analogous to that of the hydrogen bands given by Richardson and Davidson (*Proc Roy Soc*, A, **123**, 54, 466, A, **124**, 50, 69), as will be best apparent from a description of their peculiarities From the red to the violet we have the following branches

Transition	Description of the Bands	Richardson's	Finkelburg and Mecke
$\sigma\Sigma \rightarrow 2\pi\Sigma$	P and R branch of about equal intensity	${}^1A \rightarrow 2^1S$	${}^3D \rightarrow 2^3S$
$\delta\Sigma \rightarrow 2\pi\Sigma$	R strong P weak	${}^1C \rightarrow 2^1S$	${}^3P_2 \rightarrow 2^3S$
$\delta\Pi_b \rightarrow 2\pi\Sigma$	Only strong Q	${}^1B \rightarrow 2^1S$	${}^3P_1 \rightarrow 2^3S$
$\delta\Pi_a \rightarrow 2\pi\Sigma$	P strong R weak	${}^1A \rightarrow 2^1S$	${}^3P_0 \rightarrow 2^3S$

In addition to these seven branches there is one more P, Q, and R branch arising from $\delta\Delta_{a\ b} \rightarrow 2\pi\Sigma$ transitions These branches are very faint, and their intensities make it probable that they are only present if the regular precession of the orbital electronic moment of momentum around the nuclear axis is considerably perturbed It is not yet quite certain to which hydrogen bands these three branches corre spond If one takes these facts together with the arguments mentioned in the note in the *Zs f Phys*, the evidence in favour of the proposed explanation of the hydrogen bands becomes very strong The properties of the helium terms are well known (see the letter to NATURE of May 11 and a fuller discussion in print in *Zs f Phys*), and therefore I think there is no reason to accept the conception of Finkelburg and Mecke (*Zs f Phys*, **54**, p 537) of the hydrogen bands which is given in the last column of the table

All the bands the analysis of which seems most certain find their explanation in this way The in terpretation of some of the remaining terms does not seem to be easy There are reasons, however, which make it not improbable that the assignment of initial vibrational and electronic quantum numbers ought to be changed for some bands In such cases Richard son and Davidson's and Finkelburg and Mecke's analyses usually do not agree with each other

A few words may be added about the newly dis covered helium bands There are three groups of them, all belonging to the triplet system, one in the red (4σ and $4\delta \rightarrow 2\pi\Sigma$), one near 535 $m\mu$, and one near 495 $m\mu$ (5σ and 5δ resp 6σ and $6\delta \rightarrow 2\pi\Sigma$) The group near 535 was first found by Merton and Pilley It and the 495 group have been partly analysed by Fujioka (*Zs f Phys*, **52**, p 657) All the bands are degraded toward the violet The initial terms were known from other bands, the new final term $2\pi\Sigma$ lies 6118 4 cm^{-1} *above* the corresponding $2\pi\Pi$ ($2p$) term, whereas in hydrogen the $2\pi\Sigma$ level (B level) lies 8892 cm^{-1} *below* the $2\pi\Pi$ (C) level This is the most remarkable difference between the hydrogen and the helium terms, whereas in most other respects they are exactly analogous That will be seen more clearly from the detailed paper The new helium bands will be described in collaboration with Messrs Takamine and Imanishi Their dis covery also made possible the hitherto doubtful ana lysis of bands in the region around 400 $m\mu$ and 378 $m\mu$ It appears that perturbations of the kind described in my letter to NATURE of Mar 23 occur for the $\sigma\Sigma$ (s) and $\delta\Sigma$ (z) terms The perturbation moves to low or j if we go to the higher terms $4z$ (17), $5z$ (9), and $6z$ (5) are the perturbed z terms

G H DIEKE

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Groningen

The Primary Process in the Formation of the Latent Photographic Image

I HAVE read with much interest the communication from Dr F C Toy and Mr G B Harrison in NATURE of May 4, 1929, p 679 The experiments described on the photo conductance phenomenon in silver bromide afford valuable confirmation of the results obtained by Dr W Vanselow and myself on the photo voltaic effect at silver bromide silver elec trodes, which were briefly described in the sixth Hurter and Driffield Memorial Lecture[1] These results, we consider, not only demonstrated the primary separation of electrons by light in the photo lysis of silver bromide, but also gave the first evidence that this separation of electrons is actually related to the liberation of bromine The negative potential difference ascribed to electron liberation is produced within $\frac{1}{250}$ second of the incidence of the light, attaining a maximum within $\frac{1}{50}$ to $\frac{1}{25}$ second

We regard these, and other results now being published in the *Journal of Physical Chemistry*, as confirming the hypothesis of electron liberation from the bromide ion and transfer to the silver ion, which was proposed by Sheppard and Trivelli and inde pendently by Fajans, in 1921 Dr Toy and Mr Harrison interpret their recent results in terms of this same theory Now it may be noted that the photo-conductance phenomenon by itself only shows the production of mobile electrons, but not that they are *valence* electrons from the bromide ions The corre-spondence of the primary photo conductance current with the photographic effect, as demonstrated for wave length sensitivity and time order sensitivity by Dr Toy and his collaborators, is unquestionably very significant Considered in relation with our measure ments of the photo voltaic effect, they strongly sup-port the view that the inner photo electric effects—photo voltaic and photo conductance—as also the photographic and photochemical effects, all derive from the same primary separation of the electron from the bromide ion

In terming this the primary event, I take leave to differ somewhat from Dr Toy and Mr Harrison in regard to their statement on latent image formation

[1] The Formation of the Photographic Latent Image, *Phot J*, **67**, 397 414, 1928

They say "The complete building up of the latent image is now generally considered as divisible into two stages (1) The absorption of light by silver bromide and the immediate resulting mechanism, and (2) complicated chemical reactions between the product of the light action and the other substances, such as gelatin, present in the emulsion" This description seems to me incomplete, because it applies equally to the formation of the visible image It seems to me preferable to say that the primary event or elementary process is the separation of the electron from the bromide ion We have then

$$\bar{\mathrm{Br}} + h\nu \longrightarrow \mathrm{Br} + \theta$$

followed by other processes

$$\overset{+}{\mathrm{Ag}} + \theta \longrightarrow \mathrm{Ag(atom)}$$
$$\mathrm{Br} + \mathrm{Br} \longrightarrow \mathrm{Br_2}$$
$$\mathrm{Br} + \mathrm{Acceptor} \longrightarrow \mathrm{(A)Br}$$
$$\mathrm{Br_2} + \mathrm{Acceptor} \longrightarrow \mathrm{(A')Br_2} \text{ or } \mathrm{(A')Br} + \mathrm{HBr}$$

The formation of a latent image involves both the segregation of bromine *and* the aggregation of the silver atoms produced The mode of this 'aggregation' appears to me an essential aspect of the "complete building up of the latent image"

This formulation of the steps tacitly assumes that no work of predissociation or disgregation of the silver halide lattice is necessary at the interface with a conductor, as suggested in my letter in NATURE (121, 574, 1928) and discussed in detail in the *Journal of Physical Chemistry* (33, 250, 1929)

S E SHEPPARD

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The Classification of Soils for Purposes of Survey

THE growth of interest in soil surveys of recent years and the impetus given to the natural study of soil by the work of the Russian pedologists have led to considerable discussion directed towards the formulation of a world system of classification C F Marbut (*Proc Intern Congr Soil Sci*, iv 1, 1928) has proposed a scheme which amplifies the earlier classification of Glinka, using profile as affected by climate as a basis The problem of the worker in a small area will generally be the final subdivision of an area of soils mainly belonging to a single group in the world scheme

The accompanying scheme indicates an attempt to classify Welsh soils, which belong to the feebly podsolised group, for the purpose of soil survey The first division is into suites each characterised by the same or similar parent material and is, in a qualified sense, geological The next division is into phases according to conditions of formation This furnishes the series which, following American practice, are named after the localities in which they have been studied The final types are given by considerations of texture

Parent Material	Free Drainage			Impeded Drainage.	Alluvium
	Normal Phase	Drift Phase	Podsol Phase		
Igneous rocks, Pyroclastic rocks, Cambrian and Ordovician grits	Bangor	Ebenezer	Ogwen	?	?
Mona Complex	Anglesey	Gaerwen	Holyhead	Gesail	Braint
Palaeozoic sediments, except Cambrian Grits	Powys	Penrhyn	Hiraethog	Bethel	Conway
Old Red Sandstone	Monmouth	?	?	?	?
Carboniferous Limestone	Gower	Pentraeth	?	?	Talwrn
Non-calcareous Carboniferous sediments	Neath	Merton	Ruabon	?	?
Trias	Salop	Wrexham	?	?	?
Rhaetic and Lower Lias	Glamorgan	?	?	?	?

For example, soils derived from non-calcareous sediments of Cambrian, Ordovician, and Silurian age, excepting hard crystalline grits, form one suite Normal sedentary soils of this suite are called the Powys series and give such types as the Powys silt loam, Powys light loam, etc The corresponding drift soils form the Penrhyn series, soil with impeded drainage, the Bethel series, podsolised soils, the Hiraethog series, and alluvial soils, the Conway series

In addition there are a few series depending on purely local conditions of surface geology, and topographical soils, such as marine alluvium, dune, fen peat, mountain peat, and heath peat, for which it is proposed to use a descriptive rather than a local nomenclature

G W ROBINSON

University College of North Wales,
Bangor, June 5

The Origin of Adaptations

IN NATURE of June 1 there is printed the report of a lecture by my old friend, Dr E J Allen, on "The Origin of Adaptations" I do not desire to enter into a detailed criticism of the views put forward in that lecture, but in one paragraph Dr Allen refers to my views He correctly states that I believe that definite proof of the inheritance of acquired characters is available in the works of Kammerer, Durkhen, and Brecher, but that Graham Kerr and Goodrich have put forward strong arguments on the other side So far as I understand the attitude of Graham Kerr and Goodrich, it amounts to this that having convinced themselves on *a priori* grounds that the inheritance of acquired characters is impossible, they refuse to credit any evidence on the other side Such an attitude is very illuminating as to the mental outlook of these two biologists, but it is not helpful in throwing any light on the question

The question of the reliability of Kammerer's results has been placed in an entirely new light by the visit of Prof Przibram, who was Kammerer's teacher, to London. Przibram saw Kammerer's experiments performed, and in particular saw the critical specimen of *Alytes* living the sole question for him was who, during Kammerer's absence on war service, interfered with this and other specimens. He had no doubt whatever as to the *bona fide* of the experiments, for they were performed under his immediate supervision.

As to Durkhen's work on the colours of the pupae

of white butterflies, Przibram agreed with me that the experiment and the results obtained were a repetition and confirmation of Kammerer's work on *Salamandra maculosa* I think that I was the first in Great Britain to direct attention to the critical and important character of Durkhen's work and I suggested to my friend Dr Heslop Harrison, who had so much skill in breeding insects, that he should endeavour to repeat the experiment This he successfully accomplished, and this feat makes the dogmatic criticism of Kammerer's work look rather foolish

Since that time Metalnikoff, of the Pasteur Institute in Paris, has proved the inheritability of acquired immunity in the caterpillars of the beeswax moth, and this experiment is doubly interesting, because the effect on the offspring of the acquired character only became obvious after five generations, incidentally confirming Lamarck's view who rightly emphasised the importance of the time factor in use inheritance

Dr Allen quotes with approval Hertwig's statement that the real question is not "Are modifications inherited?" but How are now factors acquired?" In this statement there lurks an obvious fallacy, which one might expect from Hertwig, but not from Dr Allen There are no 'new factors' in animals Every apparently new factor turns out on close analysis to be an enhancement or a diminution of a pre existing one and the supposed difficulty of explaining the value and function of incipient characters can only be characterised as a Darwinian nightmare

E W MACBRIDE

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Cosmic Radiations and Evolution

THERE seem to be no sure grounds for believing that the penetrating radiations are uniformly distributed throughout space If they are not, and if considerable variations in the strength of those reaching the earth have occurred in the past—possibly referable to translatory movements of the solar system—then serious effects upon organic evolution may have taken place Millikan estimates their present energy as equal to about one tenth of that reaching the earth from the luminous radiation of the stars At present, therefore, the penetrating rays are probably without positive effects upon organic life It does not follow, however, that a recent decline in strength would be without serious effects

The influence of gamma radiations upon organic structures has been studied from many points of view It would seem to resolve itself finally into one of ionisation, the gamma radiations when absorbed being transmuted into beta rays Medical researches directed to the elucidation of the changes consequent upon radiations applied to healthy and to morbid tissues appear to lead to the conclusion that a selective influence is involved, the morbid tissues being destroyed by the same radiations as fail to affect the neighbouring healthy tissues, but which seem, rather, to stimulate the latter to an attitude of increased stability

This at once suggests an issue of rather sensational kind, and certainly at present purely speculative I refer to the present world wide increase of cancer in its various forms This increase might be explained as due to the disappearance in recent times of a controlling factor which, in a word, acted in the same manner as γ rays or X rays upon animal tissues

J JOLY

Trinity College, Dublin,
May 26

DR JOLY has pointed out the possibility that cosmic radiations, acting as a purely environmental factor, have produced changes in the resistance of human cells to the attacks of cancer

In this connexion the work of Goodspeed and Olson (*National Acad of Sciences*, vol 14, No 1, Jan 1928) is of particular interest These investigators have shown that a high percentage of variation in the progeny may be produced by the radiation of the sexual cells of the parents with X rays In one population of 200 plants from radiated parents there were more than 70 per cent of variant individuals Visible alterations in the chromosomes accompanied these morphological variations The results were obtained with rather intense radiation acting for a short time

From these observations it appears possible that cosmic radiations (which are of the nature of X rays) have been a factor in the production of variations by direct action on the germplasm

HENRY H DIXON

School of Botany,
Trinity College, Dublin, June 10

Electrified Omnibuses

IT may be worth while to record in NATURE an observation made by me of electrification of an omnibus Recently I was going to board an omnibus in Victoria Street and in order to do so grabbed the brass rail just as the omnibus was about to stop In doing so I received an unmistakable electric discharge On coming back after a short time I went to the same spot—opposite to the Army and Navy Stores—and put my knuckle against the rails of those omnibuses which I could touch before anyone else did so In all cases in which they came along at a brisk pace and pulled up quickly I received a sharp prick from the spark In one case a second application was rewarded by a second spark It was at a time when the sun was shining down the street and all was as hot and dry as could well be No doubt it was the scuffling of the rubber tires on the polished asphalt that gave rise to the electrification In intensity the shock, if such a term can be used, was two or three times as strong as that obtained after stroking a cat by the fire on a frosty night when a visible spark may be obtained from the cat's nose

In all my experience of omnibuses this is the first time I have noticed this electrified condition, and I have never heard of it from anyone else

C V BOYS

66 Victoria Street, S W 1, June 11

Spectrum of Trebly Ionised Bromine.

I REPORTED classification of the spectrum of doubly ionised bromine in a previous note to NATURE of Feb 16, p 244 Following that work, I have been able to classify the lines of trebly ionised bromine The chief lines of the group $N_3(O_1 \leftarrow O_2)$ have been thus located ${}^3P_2\,{}^3D_3$ line at $\nu = 36675\ 2$, the ${}^3P_2\,{}^3P_2$ at $\nu = 40130\ 8$, and ${}^3P_2\,{}^3S_1$ line at $\nu = 42247$ The singlet system and inter-combinations have also been obtained, namely, ${}^1P_1\,{}^1P_1$ at $\nu = 42177$ The differences are ${}^3P_0 - {}^3P_1 = 506$, ${}^3P_2 - {}^1P_1 = 933$, and ${}^3P_0 - {}^1P_1 = 2532$

SURESH CHANDRA DEB

Physical Laboratory,
Allahabad May 9

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The Origin of Variations

By Sir OLIVER LODGE, F R S

ARTICLES in NATURE have the advantage that they are addressed not merely to experts in the same line of work as their writer—these have to be placated rather than informed—nor are they specially addressed to the school educated general public, who are more likely to recognise the etymological character of the terms used than to appreciate their physical or biological significance Articles in these pages are, I suppose, primarily intended to reach workers in other branches of science, thereby putting them into touch with modes of thought differing from but akin to their own Our relations with each other are somewhat like those of politicians in alien countries the problems are different, the methods dissimilar, but the general aims are alike

International exchange of views is sometimes valuable, international conversation at Geneva has become possible and long may it be before NATURE is subdivided into delimited areas labelled A and B Seldom, however, does a member of one group feel entitled to intervene or say a word concerning the business of any other group If he does, he runs the risk of being regarded as a trespasser and treated with contumely That of itself would matter little What usually deters him is the doubt whether anything he has to say is likely to be of the smallest use he might be merely airing his own ignorance Well aware of that likelihood, he may nevertheless occasionally venture to intervene, with all due diffidence and dependence on the charity and better understanding of those whose knowledge is so thorough that they can afford to pardon crudenesses of expression, and be willing to give favourable interpretation to presentations from another point of view

These remarks are introductory to some comments on this year's Joseph Hooker Lecture before the Linnean Society, by Dr E J Allen, on " The Origin of Adaptations ", as partially reported in NATURE for June 1, page 841, and without further apology I would thank him for this concise summary of opinions on so interesting a subject—first explicitly treated, so far as I know, by Bateson many years ago

Take then the question of heredity, on which so much turns Certain truisms may safely be laid down The only material transmitted to descendants is the germ-plasm (using that term comprehensively as including germ and sperm) No portion of the soma is transmitted, and therefore changes in the soma can only be inherited if they are such as to modify the germ plasm We know, however, that that substance is modifiable by slight changes in the environment, and hence it would appear quite possible for body changes to have their due effect Such change may be imperceptible, except when tested by the actuality of inheritance, they might otherwise escape observation hence only experience can tell us what is heritable The body is the organ which gains experience of surrounding conditions and adapts itself to them, whether it can transmit any part of such adaptation to the germ plasm can only be effectively tested by observation of the descendants If no such transmission occurs it is difficult to see how racial experience can contribute to progress I gather that observation shows that evolution proceeds in such a way that descendants are on the whole better adapted to their surroundings than their ancestors, and further, that improvements do not proceed as if executed in accordance with some preconceived set plan, but that they are flexible and able gradually to follow unexpected changes in the environment which could not have been foreseen Inheritance of modifications may be slow, but changes or adaptations of an individual may be quick, as when a flat fish rapidly and surprisingly adapts its coloration to suit the background on which it is placed In other words, adaptability of a somatic kind exists in the individual as a fact of observation, so that there is no question about the possibility of individuals adapting themselves to circumstances The question is how more serious adaptation, to permanently changed surroundings, can be conveyed to descendants

The first *vera causa* suggested is natural selection and survival value Permanent modification may result from the improved chances of life for those individuals who happen to be born with some approach to the favourable variation or mutation, subject to the added proviso that such innate peculiarity is transmissible by inheritance This doctrine, though apparently true so far as it goes, obviously does not explain how the variation arises it only acts as a lock to secure its continuance in the race when it has arrived The problem of the origin of the variation is deeper than that The survival of the fittest or the elimination of the unfit, alone, is little more than a shipwreck experience

I will now make a quotation or two from the article referred to, and as it is so accessible, and this is not a controversial epistle, I will not hesitate to introduce into my quotations words in square brackets that are not in the original In the second column of page 843, I read

> " That evolution proceeds according to laws of the same character as other [known] laws of Nature, is the common basis of all modern evolutionary theory, and was held perhaps more strongly by Darwin, Huxley, and Weismann than it is by some writers of to day "

The word " known " which I have thus introduced is surely important, for if it be omitted I do not see how anyone could doubt the statement Every event must happen in accordance with laws of Nature in the widest sense But as to whether at any given period those laws are all known, or rather whether the laws known to a particular generation are sufficient as a basis from which to explain every recognised phenomenon, may very well be doubted That, I presume, is the only point on which modern

writers can differ from what may be called the Huxley point of view—or, to make it impersonal, say, from the view that the fundamental knowledge of Nature already acquired by humanity is sufficient to account for all observed phenomena Those phenomena have been added to since the middle of last century, and everyone who knows anything of Darwin and his great protagonist must realise how eagerly the newer experimental results would have been assimilated and utilised by them

GUIDANCE AND CONTROL

The question which still remains open, as worded by Dr Allen, is ' *how* the soma influences the factors in the germ cell " Well, that is one way of putting it, from the material point of view and an interchange or circulation of hormones has been suggested as a material method For paternal inheritance this particular method may possibly lack cogency, but doubtless some machinery will be found, one can scarcely expect to see changes produced in matter without *some* appropriate mechanism ! But that alone does not solve the problem There is about the process a suggestion of purpose, as if, like all other mechanism, it were constructed for a definite object, and designed so as to work in a particular way A random circulation of hormones, or of anything else, could scarcely be trusted to effect the precise changes which, having originated in the soma and possessing survival value, ought to be transmitted to the germ plasm so that they may be inherited Hormones may, for all I know, constitute the material means of conveyance, but how do they exercise that function ? And what initiates or controls their activity ? So much is left unexplained even when the machinery is discovered

Material mechanism is just what can be followed by those whose business it is to study the physical basis of life, but mechanism is never self explanatory The most automatic mechanism ever constructed must have mind behind it, not indeed in its contemporary working, but in its design and purpose, and if the result of mechanical working simulates the effect of purpose, it may be wise to keep our minds open to the possibility that after all there may have been some purpose, or so to speak intention, in the change that is being observed and in the adaptation of the means The mechanism whereby a flat fish (to go back to that merely popular illustration) changes its pattern when greater concealment can be thus secured, has I believe been made out certain pigment cells swell, while others contract That the animal knows what it is doing is quite unlikely the mechanism presumably works automatically But surely biologists scarcely feel that they have got to the bottom of the problem when they merely point out the mechanism !

Some biologists apparently realise that a statement in terms of automatic working is not ultimately satisfying, and are said to have introduced " the idea of some psychic or psychoid influence, controlling and regulating the processes of metabolism and organic growth ", which idea is deprecated by Dr Allen, in common I suppose with many others, as too like " the animisms of primitive man ", too suggestive of conscious purpose, " such as we know only in ourselves, or by analogy assume in higher animals "

Purposive action and planning, however, do after all exist in the universe, and therefore may have to be taken into account in ways of which we at present have no suspicion It is true that the higher animals who thus act for the future have " an elaborately differentiated nervous system ", but that is only part of the mechanism for the forming and carrying out of a purpose A machine does not really explain the rationale of its own action no machine is able to do that The most elaborate machine is a mere executive

Suppose we revert to an earlier position and ask, How do we know that germ plasm may be influenced and modified or adapted to new and unexpected conditions? Doubtless we know it in several ways, but among others by the direct experiments mentioned by Dr Allen in the second column of page 842, where we are told ' that the germ plasm itself can be acted on by physical and chemical forces in the environment in such a way that mutations are produced " For

> ' Harrison has shown quite clearly that the germ plasm can be changed by chemical substances contained in the food of an animal, or in more general terms that the germ plasm can be altered by the environment "

Here, then, is a change which has been produced through proper physical and chemical means and has resulted in a mutation But surely Dr Heslop Harrison may be not impolitely called " a psychic or psychoid influence, controlling and regulating the processes of metabolism and organic growth ", and H J Muller, by finding the correct dosage of X rays for mutation production, seems to be another of those influences An imaginary observer able to watch the processes, but from whom the operator was concealed, might feel impelled to infer him But indeed we need not appeal only to recent advances The long established procedure of breeders, and even of gardeners, long ago showed that mental operations—put into effect by a nerve muscle system—were able to guide and direct the ordinary forces of Nature so as to produce variations almost at will The beneficent progress of discoveries in agriculture, from which ultimately we hope so much, is an outcome of this purposive activity of a " psychic or psychoid influence " Such an influence is therefore another *vera causa*, which may be more widely operative than at present we imagine

CONCEALED INFLUENCES

It will be said, however, it is quite unfair to bring in the operations of a highly organised product of evolution, and use that as an analogy for what occurs in connexion with low organisms without any trace of psychic or even nervous development How is it possible for anyone who wishes to adhere closely to the laws of Nature to think of any other

influences than those displayed by the organisms themselves? How can we detect concealed influences? If we attend only to matter, and to those laws which have been already ascertained, I admit it may be impossible. But a physicist is not limited to the contemplation of matter. He regards the behaviour of matter chiefly as a sign or indication of what is going on in space. Faraday showed that the phenomenon of electric charge would never be properly understood by attending to matter alone: he traced the electric field to a property of space. Charged conductors are only the boundaries or terminals of an electric field existing *in vacuo*. Similarly Poynting showed that an electric current is not propelled by anything occurring in a metallic conductor, but by an influence reaching the conductor through space. The energy of the sun reaches the earth in that sort of way. Atoms act on each other across intervening space, and it is to space that modern physics turn for explanation of cohesion, elasticity, and of what used to be called 'gravitational attraction'.

In fact, it may be said that modern physics attends very much to space and its properties, and utilises matter mainly as an index, demonstration, or manifestation of those properties. The very electrons of which matter is composed are spatial peculiarities, and seem to have more affinity with waves than our scientific ancestors suspected. An electric current, considered materially, is a procession of electrons; but the driving power is not an end thrust like that of water through a pipe: the propulsion is a lateral propulsion exerted by electromotive forces which reach the conductor through the surrounding medium, along paths which can be mapped out.

Undoubtedly we are dependent on matter for every observation; we cannot study even ether or radiation without it; occurrences in space are concealed from us, they have to be inferred. For example, a magnetic field is an etheric or space phenomenon, and yet, admittedly, it is by aid of the properties of matter that we explore and investigate such a field. But matter after all is secondary; it displays and locates the phenomenon: it helps us to deal with it and make experiments upon it; yet an actual magnetic field is turning out more like a circulation in space than anything else. Before the discovery of electric currents, the only magnets known were natural magnets and those which had been propagated from them by regulated movements. One magnet could produce any number of others, without being itself weakened, and there was no magnetism without antecedent magnetism. The parable is obvious.

The progress of science in that department, however, led on to the production of artificial magnets, electromagnets, whereby fresh magnetism could be generated by setting electricity in motion. Yet, even so, 'generated' is scarcely the correct term. The act of magnetisation seems to be only the utilisation and opening out of circuital relations which already exist, so that instead of being shut up into infinitesimal configurations they are displayed openly and made manifest. Pre-existing but imperceptible magnetism could be incarnate in matter and exhibited. All matter has close relations with the space surrounding it. Radiation is a constant means of communication, not only obviously, but also secretly, in ways only recently discovered. An atom under certain conditions can emit energy into space, and can receive energy from space; and all material activity is the result of this interchange of energy. In space, the energy is what we call potential; in matter, it is what we call kinetic. The one form is continually passing into the other, and back again.

It must be admitted that analogies prove nothing, but they are sometimes suggestive. My suggestion is that life is something which primarily exists in space, though we only know of it when it is associated with and displayed by matter. I venture to say that we shall never understand life so long as we attend to its material manifestation alone. We must always use matter as our index and means of exploration, because it is matter alone that appeals to our senses; but the reality may lie beyond or behind matter, and may only interact with it for a time. We should never have understood the laws of an electromagnetic field, and the nature of radiation, by theorising as if matter were supreme. Even now we scarcely understand the nature of gravitation, though we can apply its laws with considerable success to the motions of material bodies. Similarly, the nature of life is unknown, though a vast amount has been learnt about living bodies.

I would ask biologists to consider whether they could not, as a working hypothesis, begin to contemplate life as something existing in space as in a sort of infinite reservoir, out of which it could under appropriate stimulus enter into association with molecules of sufficient complexity to enable it to catch hold and become as it were incarnate. They might go on to suspect or infer concealed mechanism, not of a perceptible material kind, but still possibly of a physical nature, activated by something at present unknown. I suggest that concealed powers have put the organism together, in a specific form, out of such materials as came to hand. When the machine goes out of order the controlling powers cease to be able to display themselves: the instrument of manifestation is spoilt. But we need not jump to the conclusion that when they related themselves to matter they came into existence, and that when they leave matter they cease to be.

Few of the controlling powers can have attained an individual or personal existence, but we know that matter, in its more complex and higher protoplasmic forms, has been the means of individualising those concealed activities; and consequently, as developed personalities, we ourselves are able to testify and help the explorers. If they made use of all the information available they would have a wider scope for contemplating the apparently purposive movements of live things, and might realise that in studying as they do the material basis of life, they are studying the influence of some

controlling entity—perhaps etheric, perhaps psychic, probably both—by aid of the material mechanism which it utilises

CONDITIONS FOR VITALITY

There are certain narrow conditions which have to be satisfied before live things can appear—a certain narrow range of temperature, the presence of chains of carbon atoms and perhaps of oxygen and liquid water—all of which are commonly called the conditions necessary for life to exist I would rather call these the conditions necessary for vitalising or animating matter—the conditions for vitality, in other words, the conditions enabling life to enter into association with matter I admit that it is the peculiar behaviour of organised cells that we commonly designate by the term 'alive', but we must not be too much hampered by our use of terms Animated matter displays life, and the display or manifestation of life we might call vitality When vitality ceases we are apt to imagine that life has gone out of existence But we do not think that electricity has gone out of existence when a body is discharged, though it is no longer electrified, nor need we think of magnetism as going out of existence it can become concealed and go out of our ken Nor do we think of electricity as ever coming into existence—at least not under observation, it can be localised so as to display itself by material effects Animated matter behaves in a curious way, and so does electrified or magnetised matter A compass needle points north and south, as if mysteriously cognisant of those regions but everyone knows that it is only acted on by the peculiarities of the space near it

Similarly, if we try to understand apparently purposive action in animated matter, we may fail unless we realise more clearly that something is controlling and being itself displayed by that matter An electrician uses a compass needle or a filament to display or manifest an electric current, but he would not understand much about the current if he limited himself to a discussion of its material manifestation Nor do I think that we shall understand much about heredity, and the other strange occurrences dealt with by the biologist, so long as we attend only to the material vehicle or instrument of life Life enters into a nascent organism gradually, as its cellular constitution is enabled to receive it, and when, in the long course of evolution, an organism has attained sufficient complexity, the higher stages or aspects of life, called mind and consciousness, enter or are manifested too But a study of the mechanism alone will never detect more than an indication of our thoughts, plans, hopes, and aspirations, nor can we thus explain consciousness and our power of understanding what is going on in the material explored

One more quotation from Dr Allen in conclusion, with which, I need scarcely say, I heartily agree, especially if extended by the words in square brackets

"In whatever direction we look problems bristle, problems open to successful attack, and the old qualities, insight, patience, and determination, will get them solved But we must not limit the outlook, and all aspects of biological research must proceed hand in hand Botany, zoology, palæontology, the work of the systematist and of the field naturalist, the study of structure and the study of function, the work of the embryologist and of the experimental physiologist, of the geneticist and of the statistician [aye even of the physicist and the psychologist], all are necessary, and none can succeed without the others"

The Joint Meeting of the French and British Associations at Havre

IN 1914, while the British Association was meeting in Australia, the delegates of the Corresponding Societies were invited as guests at the conference of L'Association Française pour l'Avancement des Sciences, then being held at Havre Those who were present will remember the hospitable way in which they were entertained at the Hotel Frascati, at the meetings and excursions, though as day by day passed there seemed to be something mysterious going on, the hotel gradually emptied, there were signs and whisperings, the members were impressed by the enormous accumulation of foodstuffs in the warehouses, and before the meeting was closed the declaration of war explained a good deal The members had to find their way back to England as best they could, and those who had the experience will never forget it

The French Association, towards the end of July this year, again meets at Havre, and as the principal members of the British Association will then be at South Africa, our French colleagues have again extended the courtesy of inviting the other members of the British Association to attend its conference at Havre without any extra fee beyond the ordinary subscription to the British Association which would be paid in any case

In addition, the French Association has invited the delegates of the Corresponding Societies to hold their conference during the Havre meeting, and in connexion with this a sub committee was appointed consisting of the president of the Conference of Delegates, Dr F A Bather, the secretary, Dr C Tierney, and the acting secretary for the Havre meeting, Mr T Sheppard Sir Henry G Lyons was also appointed the official representative of the British Association and chairman of the organising committee referred to

At the Glasgow meeting of the British Association, Dr A Loir, whose courtesy was so much appreciated in 1914, was present and gave an official invitation to the General Committee of the British Association and was prepared to do the same for the Conference of Delegates, but apparently that body was too fully occupied to spare the necessary time Mr T Sheppard has recently visited Havre and met the chairman of the Local Committee (the English Consul, Mr H C Swan), Dr Loir, and others interested in the local arrange-

ments The Hôtel des Sociétés Savantes, next to the Lycée de Garçons, where the meetings of the French Association will be held, has been generously placed at the disposal of the British Association for any special meetings, etc These rooms provide a general meeting room for the delegates, a committee room, and an exhibition room During the conference, Dr Bather will give an address on museum matters to a section of the French Association, and Dr Pullein will speak on radiology at the request of the Association The Conference of Delegates will be held at 5 P M on July 26, when the question of the Channel Tunnel from both engineering and geological points of view will be discussed The British committee is arranging an exhibition of air photographs, regional survey maps, etc

The French Association commences its programme on Thursday, July 25, at 11 A M, when the opening session will be held at the Grand Theatre In the afternoon is the organisation of the sections, and in the evening a reception by the Corporation at the Town Hall On Friday, July 26, there will be papers and discussions, visit to exhibitions organised at the Lycée de Garçons, natural sciences by the Geological Society of Normandy and the Linnean Society of the Seine Maritime, and exhibits by the civil engineering, dentistry, meteorological sections, etc, visit to the Port and a liner, and a conference at the Grand Theatre On Saturday, July 27, there will be a visit to the English exhibitions and museum, visit to the museum at Old Honfleur, and a public conference in the Franklin Hall Sunday, July 28, will be occupied by a general excursion to Fécamp, and the unveiling of a monument to Dr Léon Dufour On Monday, July 29, further discussions, visits to various buildings, and in the afternoon an excursion to the Art Gallery and New Archæological Museum at Graville Abbey In the evening there will be a soiree at the Municipal Casino or on a liner Tuesday will be occupied by papers and discussions and the closing session On Wednesday, July 31, and Thursday and Friday, Aug 1 and 2, there will be final excursions to Grouville, Lisieux, Caen, Bayeux, Mont St Michel, and Rouen and district

Inquiries in reference to the meeting should be addressed to Mr T Sheppard, at the Museum, Hull, or to Dr A Loir, Comité Local, Hôtel de Ville, Le Havre, France

News and Views.

ON June 26 the centenary occurred of the death of James Lewis Smithson, who by his will, dated Oct 23, 1826, left his fortune "to the United States of America to found at Washington, under the name of the Smithsonian Institution, an establishment for the increase and diffusion of knowledge among men" Born in France in 1765, Smithson was the illegitimate son of Hugh Smithson (1715–86), who married the heiress of the Percy property, took the name of Percy, and in 1766 was made Duke of Northumberland, and of Mrs Elizabeth Macie, widow of James Macie, of Bath He was known during the first half of his life as James Lewis Macie, and under that name he entered Pembroke College, Oxford, graduated as M A in 1786, and was the following year admitted a fellow of the Royal Society His attainments in chemistry and mineralogy were vouched for by Kirwan, Blagden, and Cavendish, and Smithson's life was mainly devoted to scientific studies He travelled and lived much abroad, counted among his friends and correspondents, Davy, Thomson, Cavendish, Biot, and Arago, contributed some 27 papers to the *Philosophical Transactions*, Thomson's *Annals of Philosophy*, etc, and collected a great mass of notes on various subjects His death took place at Genoa, and his grave, until the end of 1903, was to be seen in the little English Cemetery on the heights of San Benigno overlooking the Gulf of Genoa Early in 1904 his remains were exhumed and, under the supervision of Alexander Graham Bell, conveyed to Washington, where they now lie in a mortuary chapel in the great institution founded through his action

SMITHSON'S fortune came to him through his mother, who could claim descent from Henry VII and was connected with the Hungerford family of Studley In his will he directed that his property should first go to a nephew, Henry Hungerford, and it was in the case of his nephew's death that it was to go to the United States It was not until 1837 that any of the money was received in America, and a further nine years elapsed before Congress decided to accept the trust and found the Institution The Board of Regents designated by the Government met on Sept 7, 1846, and one of their first acts was to appoint Prof Joseph Henry, of Princeton, as secretary It is not too much to say that it was largely owing to Henry's foresight, energy, and broad mindedness that the Smithsonian Institution soon gained an international reputation Henry has been succeeded by Spencer Fullerton Baird (1878–87), Samuel Pierpont Langley (1887–1906), Charles Doolittle Walcott (1907–1927), and the present secretary, Dr Charles Greeley Abbot "Smithson's wishes", wrote Langley thirty years ago, "have been carried out by those immediately administering them with a constant scrupulous thought of the intent of the founder, while in doing this the best results have flowed from a rigid construction of his own words, so briefly expressed, and from a division of the activities of the Institution into two great distinct but parallel paths, the 'increase' and 'diffusion' of knowledge" The motives which led Smithson to leave his money to the United States will probably remain unknown, but we are in no doubt as to the admirable manner in which his wishes have been carried out or of the fruitfulness of his bequest

IN his presidential address to the Pharmaceutical Conference in Dublin on June 25, Mr R R Bennett dealt with some aspects of materia medica in which a rational use of drugs has replaced a crude em-

principism, owing to recent advances in chemistry and physiology and in the science and practice of medicine Such increased knowledge has led to improvement in the public health, and to the discovery of new remedies the beneficent effects of which are world wide in their application In the tropics especially, knowledge of the natural history of parasitic diseases and the discovery of drugs exerting a curative effect have led to a measure of control which makes available for human habitation large tracks of otherwise unhealthy country In this work the part played by synthetic drugs is of great importance but in spite of the discovery and use of powerful new remedies our knowledge of the relationship between chemical structure and physiological action is fragmentary It can only be increased by the systematic preparation of new compounds and the examination of their pharmacological properties In this connexion the establishment of a chemical research laboratory at Teddington under the general scheme of research directed by the Department of Scientific and Industrial Research must be regarded as an experiment of great interest In collaboration with the Medical Research Council, an endeavour is to be made to obtain experimental evidence of the relationship between constitution and activity

NEW remedies or methods of treatment are often of respectable antiquity Mr Bennett mentioned that ephedrine which has found a place in the treatment of asthma, is similar both chemically and pharmacologically to adrenaline it was isolated, but not used, fifty years ago the Chinese, however, have employed the crude drug for more than two thousand years Again, animal preparations were used as medicinal agents, only to fall into disfavour now they are coming into vogue again, and some exert a specific effect in certain diseases, for example, liver and its extract in the treatment of pernicious anæmia, or thyroid gland and its active principle, thyroxin, in the treatment of cretinism The tendency is to replace the crude drug with the active principle extracted from it, then the latter is prepared synthetically, often more cheaply than the natural product, and except for the fact that the synthetic compound requires resolution into the optically active isomers, it is identical with that prepared in Nature's laboratories But modern remedies include more than is implied under the term drug' organotherapy is assuming as important a place as chemotherapy, vitamins can be prepared in concentrated form, and, finally, bacterial products play an indispensable part in the treatment of many diseases Vaccination for smallpox, antitoxins for diphtheria or tetanus, and still more recently inoculation for canine distemper and yellow fever indicate the wide range covered by the modern use of the term remedy Finally, it must not be forgotten that physical methods also play their part, of which the use of radium in cancer may be considered a most notable example

THOUGH the loss of life was fortunately small, the earthquake that occurred in New Zealand on June 17 appears to have been the strongest felt in that country since 1855 The epicentre lay in the north west of the South Island, the greatest damage having been done at Westport Greymouth, and Murchison At these places scarcely a building escaped serious injury At Nelson a tower fell, so that the area of damage must have been more than 150 miles long in the south south west direction and about 50 or 60 miles in width In the epicentral area, landslips were unusually frequent and large, and indeed most of the fifteen deaths reported seem to have been due to landslips rather than to the fall of buildings Our record of New Zealand earthquakes is a brief one but in the century that has elapsed since 1826 no other prominent movement appears to have occurred in the centre recently in action The three great earthquakes of Oct 16 17 and 19 1848 visited a district fifty miles or more to the east, in the chain of mountains that runs south south west from Cloudy Bay along which a remarkable fissure 60 miles long was then formed The still greater earthquake of Jan 23 1855 occurred in the south east end of the North Island its epicentral area being in or near the continuation of that of the earthquake of 1848 With this earthquake, an area of 4600 square miles was raised from one to nine feet, the greatest elevation being along the line of the Wairarapa Valley

AMONG the recent additions to the British Museum (Natural History) are the late Dr J de Bedriaga's herpetological collections and a selection of books and pamphlets from his library, presented to the Department of Zoology by Dr G A Boulenger This collection (1306 specimens) is especially rich in representatives of the numerous races of the wall lizard from the islands of the western Mediterranean The books and pamphlets, 159 in number are almost all works or editions new to the zoological library of the Museum Dr Hugh Scott and Mr J Omer Cooper have presented to the Department of Entomology some 40,000 insects collected in Abyssinia during their expedition to that country in 1926–27 The entomology of the high plateaux of Central Abyssinia, where these collections were made, has been relatively very little investigated, but is of great interest owing to the peculiar mingling of tropical African, northern, and Oriental forms Certain small groups already worked out show a high percentage of species new to science

THE collection of Lepidoptera made by the late Mr A E Wileman during his thirty years consular service in Japan, Formosa, and the Philippine Islands, which consists mainly of moths and comprises some 25,000 specimens, including nearly 760 types, has been presented to the British Museum (Natural History) by Mrs Wileman in memory of her husband Dr J M Aldrich, of the United States National Museum, Washington, has presented a series of dried larvæ of a Saturniid moth, *Coloradia pandora*, Blake, from the Mono Lake district, California The caterpillars of this moth feed on the needles of a species of pine (*Pinus jeffreyi*) at an altitude of some 7000 feet, and are collected, dried, and used as food by the local Indians The life cycle of the insect occupied

two years, and, as an indication of the numbers in which the caterpillars sometimes occur, an Indian chief is said to have prepared a ton and a half of these larvæ during a single summer The Department of Mineralogy has received from Mr F N Ashcroft a further selection of about a thousand mineral specimens, representing more than a hundred Swiss localities With Mr Ashcroft's previous donations of Swiss minerals and those bequeathed by the Rev J M Gordon in 1922, the Museum now possesses the finest collection extant for illustrating the conditions of mineral growths in the special type of Alpine veins

SIR RICHARD GREGORY's presidential address to the Royal Meteorological Society last January, entitled "Amateurs as Pioneers", which has just been published (*Quar Jour Roy Met Soc*, vol 55, No 230), deserves to survive as a chapter in the history of British science Nowhere in the world has the amateur flourished as he has in Great Britain, and he flourishes still It has often been pointed out that, though it is easy to beat the Englishman in the field of high specialism and technique, if the view be extended so as to take in the larger number of amateurs and fairly good performers in any branch of study or of sport, Great Britain may face the world In this matter it is the same with tennis as with Greek, with chess as with meteorology Sir Richard is concerned mainly with contributions to the last named subject His contributors range from the Rev William Merle or Morley, who went from Oxford to be rector of Driby in Lincolnshire in 1331 and kept a systematic record of the weather for seven years, down to the amateurs of the present day, who have set up two way radio communication between England and the Antipodes on a wave length of 80 metres

METEOROLOGY has been a favourite field for the amateur In 1846, James Glaisher, following a long line of amateur observers, was able to correct a false conclusion published by the Registrar General as to the relative temperature of London and York As a result he was requested to collect suitable observations for inclusion in the "Quarterly Returns of Marriages, Births, and Deaths" He thereupon formed a band of 50 to 60 voluntary observers who became the nucleus of the Royal Meteorological Society and the pioneers of the Meteorological Office The exploration of the air has been the special triumph of the amateur The same Glaisher became famous as a balloonist, and some stirring pictures are published in this pamphlet of his experiences, ascending and insensible, at the height of seven miles The Royal Society itself, indeed, and practically all the pioneers of the seventeenth century, were amateurs, at a time when the universities were close in the grip of religious controversy and Aristotelian dialectics It was men out of touch with this who first came together in Oxford, and afterwards consolidated their efforts in the Royal Society in London They were mostly men of means, and it would be well for us if as large a proportion of that class were amateurs of science to day

SINCE 1846 the only material changes in the scope of the United States National Museum have been the addition of a department of American history, and in 1920 the separation of the National Gallery of Art as a unit Now, as the Report for 1928 shows, there is imperative need for further accommodation for purposes both of exhibition and storage of study collections Especially, it would appear, has natural science suffered, since exhibits of animals have been curtailed to make way for historical subjects, and space designed for anthropology has been pre empted for objects of art In view of this contraction of natural science in favour of other studies, we turn with interest to the records of visitors, which give an indication of the comparative interest taken by the people in the different groups of exhibits In the first complete year in which natural history is treated as a separate group, the number of visitors to this section was 151,112, while 'arts and industries' claimed 207,010 But now (1927–28) the numbers are respectively 618,773 and 517,238, and this scarcely gives the true contrast, for a glance shows that natural history must have claimed on an average during the last eighteen years about 200,000 additional visitors a year Thus the public gives little excuse for extending art at the expense of natural history A large part of the Report deals with the activities of each of the departments, in acquisition, research, exchange, and so on The extent of the collections which have now been amassed may be judged by the fact that the department of geology possesses more than two million specimens, and biology well over eight million It is sad to read that of the 333,329 birds in the collection, 8126 have been classed as alcoholics '—and this in a dry land

ON Jan 5, 1927, the Governor General of Canada in Council gave authority "to designate the Museum branch of the Department of Mines the 'National Museum of Canada'" Thus the Museum publicly assumes a national relationship towards which its activities have been broadening since it began as a part of the Geological Survey of Canada in 1841 During that developmental period, many changes have taken place Gradually the purely geological activities have had added to them anthropology, biology, and palæontology, each now claiming a division of its own At the same time, various transferences of site have moved the Museum, first from its original home in Montreal to Ottawa in 1880, and there, finally in 1910, to the handsome Victoria Memorial Museum, where the collections and staff have since been housed, except during a partial and temporary dispossession, from 1916 until 1920, when, their own Parliament House having been destroyed by fire, members and senators transferred their activities to the Museum building An account of the history of the Museum and of the developments due to each of its successive directors, from Sir William E Logan to the present day, has been written by the acting director, Mr W H Collins, for the Annual Report for 1926, just published, the first of a series of reports proposed to be devoted wholly to the interests of the National Museum of Canada.

THE Council for Scientific and Industrial Research for the Commonwealth of Australia has issued its second annual report (Canberra H J Green, 1929 1s 8d) The Council, being a new department, is still mainly occupied in building an efficient research institution to co operate with existing institutions in solving many pressing national problems Although some investigations have been initiated, the Council has principally taken over investigations that were in progress Four divisions, each under a chief, have already been formed They are animal nutrition, economic entomology, economic botany, and forest products A fifth division to deal with animal health is in course of formation So far the Council under takes to carry out extensive investigations only in those fields where it has been found possible to find a suitable chief of the division The report dwells on the lack of efficient research workers in Australia in the fields where work is most required, that is to say, in pastoral and agricultural problems A plea is made for the more extensive training of research workers in the biological sciences The difficulty is partly overcome at present by extensive co operation with the Australian universities and the State depart ments of agriculture The report contains notes on many valuable lines of research now under way

THE Australasian Antarctic Expedition (1911–1914) Scientific Reports, Series B, vol 2 (Terrestrial Magnetism and Related Observations), Part II, issued in March 1929, is devoted to a discussion of "Magnetic Disturbance and its Relations to Aurora", by the late Dr C Chree (Sydney Alfred James Kent 15s) Of the 132 pages in this part of vol 2, 53 are occupied by tables and 79 by text, it is to be regretted that no summary of the conclusions resulting from this long discussion is included Of the four chapters, one only is devoted to the connexion between auroræ and magnetic disturbance, when auroræ are specially intense, so also, in general, is magnetic disturbance, but on more ordinary occasions there appears to be no close relationship between the two phenomena, in the Antarctic The other chapters deal with daily and hourly character figures for dis turbance, the international daily character figures are found to be on the whole indicative of Antarctic as well as of non polar conditions

THE Department of Embryology in the Carnegie Institution of Washington has from the outset, under the late Prof Mall and now under Prof G L Streeter, pursued a policy of close association with other departments engaged in related work in its own institute and in the Johns Hopkins University and Medical School, as well as with the general medical profession The policy has been a fruitful one for the study of human development, for many of the re searches summarised in *Year Book* No 27 could only have been carried out upon material obtained from such outside contacts The programme of study is of the widest character More than forty investigations have been completed or were in progress during the year reviewed, to June 30, 1928 They included researches on the differentiation of primitive tissues from the mammalian egg, the origin of the human heart, the locomotion of white blood cells, organo genesis, and the functions of the corpus luteum and other ovarian structures A monkey colony recently established has yielded interesting results bearing upon the duration and symptoms of pregnancy and the act of parturition, while many studies have been devoted to the nervous system, particularly to the correlation between function and structure, and to the phenomena of growth in the higher primates and man

VOLUME 19 of "Contributions from the Jefferson and Cruft Laboratories of Harvard University" contains reprints of 72 papers by the staff and research fellows which have appeared mainly in American scientific journals during the years 1926–27 Ten of these papers are by Prof P W Bridgman, who has continued his work on the properties of substances under high pressures Prof E H Hall contributes five, mainly on the emission of electrons from the surfaces of bodies, and Prof Lyman four on ultra violet spectra Prof Duane and Dr R J Havig hurst, a research fellow, are responsible for ten on crystal analysis by X rays, and Prof R S Mulliken and two research fellows for eight on the relations between band spectra and electronic structure of the emitting molecule Dr J C Slater contributes five and Dr E E Witmer a research fellow, four on the structure of atoms and the bearings of wave mechanics on the subject Prof G W Pierce describes his magnetic oscillators, giving frequencies from a few hundred to 300 000 per second A rod of magnetisable material passes through the centres of two coils, one connected to the filament and plate, the other to the filament and grid of a valve with a condenser in the circuit The oscillating currents produce changes of length of the rod, and the apparatus is much more convenient than the piezo electric generator The volume maintains the high standard its predecessors have led us to expect from Harvard

WE have received a copy of the prospectus an nouncing the sixth great exhibition of chemical apparatus and machinery to be held at Frankfurt on Main on June 10–22, 1930 The brightly decorated cover shows the remarkable growth in size of success ive exhibitions since the first of its kind was held at Hannover in 1920, and it is confidently expected that the Frankfurt exhibition will excel in importance even that held two years ago at Essen Many foreign countries will be represented among the exhibitors, and members of the *Dechema* (*Deutsche Gesellschaft fur chemisches Apparatewesen*, Seelze, bei Hannover) will receive special privileges Frankfurt is described as the greatest centre of chemical industry in the world In addition to this, the manufacture of chemical machinery and apparatus has grown to very considerable importance in the neighbourhood The exhibition will be held in four large halls, which are housed in three main buildings, plans of which are given The main avenues in the exhibition bear the names of famous chemists—Liebig, Bunsen, Wohler, Emil Fischer, Nernst, Ostwald, Baeyer, Willstatter,

Goldschmidt, Raschig, and others The first hall will contain scientific apparatus and instruments for laboratory use, technical measuring instruments, and also the postal department, press rooms, and writing rooms In the second hall will be found porcelain and stoneware and products of the ceramic industry Machinery and appliances used in the industry of oils and fats are to be assembled in Hall 3, a section of which will be devoted to the chemistry of daily life, whilst in the fourth hall large technical apparatus and machinery used in chemical industry, together with complete exhibitions of plant and processes and also raw and other materials, will be found

The forty first Congress and Health Exhibition of the Royal Sanitary Institute will be held at Margate, at the invitation of the Town Council, on June 21–28, 1930

In Nature of May 25, p 795, Messrs C von Bonde and J Marchand described a case of 'Siamese twins' in the spiny dogfish We find that similar twin dog fish were caught by a trawler in the English Channel and landed at Newlyn on Aug 25, 1928, and a repro duction of a photograph of the specimen was published in the *Fishing Gazette* of Dec 22, 1928

Referring to the note on p 922 of Nature of June 15, on a course of electrostatic methods in biology in Basel, Mr R Keller points out that it is scarcely correct to state that he and his colleagues "are introducing physical methods into biochemistry" This has already been done by other workers The Prague school is specialising on certain electrostatic *microscopical* methods

In order to facilitate the work involved in preparing the annual publication of "Organic Syntheses", the editorial board has been fortunate in securing the co operation of Dr C F H Allen, of Tufts College, Mass, who is acting as secretary to the board All correspondence regarding 'Organic Syntheses" may be addressed to Dr Allen, who will receive contribu tions to be considered for publication in future volumes

The Old Students' Association of Faraday House Electrical Engineering College has this year elected Dr Alexander Russell as its president to com memorate the fortieth anniversary of his appointment on the staff of the College It was in 1882 that the Hammond Electrical Engineering College for training electrical engineers was founded, and it was in 1889 this was merged in the present Faraday House College Since then, some 2050 students have entered Faraday House, and of these more than 900 are members of the Old Students' Association A portrait in oils of Dr Russell, by Miss A M Burton, has been presented to the Governors by the artist's brother, Mr R G Burton, who was at Faraday House during 1912–1915, and is now with the well known firm of Messrs A Reyrolle and Co A reproduction of the portrait forms the frontispiece of the summer issue of the *Faraday House Journal*

The drawbacks to most of the radio receiving sets at present on the market are the difficulties con nected with keeping them thoroughly clean and in good condition, the periodic charging of the low pressure accumulators, and the replacing of the high tension batteries Those who use the electric light often wonder why electricians do not use the domestic electric supply and thus get rid of both accumulators and high tension batteries Good progress, however, has been made in this direction When the domestic supply is alternating current, it is not difficult to buy quite satisfactory 'eliminators' which require neither batteries nor accumulators With direct current sup ply the practical problem of abolishing the high tension batteries has been achieved and excellent progress is being made in the direction of abolishing the accumulators Messrs Claude Lyons, Limited, of 76 Old Hall Street, Liverpool, issue a catalogue called 'Getting the most out of Radio" The ordinary scientific reader who wants to know the latest develop ments in methods of receiving broadcasting will find this catalogue very instructive Much of the apparatus described has been made by the General Radio Com pany of America The products of several English manufacturers are also described Excellent hints are given of the best methods of keeping sets in con dition As it is very difficult to get piezo electric crystals large enough to give fundamental frequencies below 25 kilocycles, we are glad to see that magneto striction oscillators can be purchased suitable for low frequencies The same firm also publishes a booklet describing a 'clarostat', an instrument which does for high resistance what a variable condenser does for capacitance It provides a method of continuously varying the value of a high resistance The material used is a highly pulverised graphite intermixed with pulverised mica The resistance is altered by applying pressure This material should also prove very useful in the laboratory

Catalogue No 169 of Messrs Dulau & Co, Ltd, 32 Old Bond Street, W 1, just issued, gives particu lars of 1200 second hand works dealing with botany and horticulture The prices asked appear to be reasonable

We have received from M Paul Lechevalier, 12 Rue de Tournon, Paris, a copy of that firm's catalogue No 114 of second hand works relating to zoology, nearly 1800 in number, published for the most part outside the British Isles

We have received from Messrs J H Steward, Ltd, 406 Strand, London, a copy of their new cata logue of surveying, drawing, and nautical instruments The catalogue illustrates a wide choice of theodolites, levels, plane tables, compasses, aneroids, drawing instruments, etc Full specifications of the instru ments are given

A Special Clearance List of instruments has just been issued by the City Sale and Exchange, Ltd, 81 Aldersgate Street, London, E C 1 It is classified, and various sections deal with field glasses, telescopes, surveying apparatus, etc, with a miscellaneous group including microscope accessories, mathematical instru ments, and a 3 inch Watson's Student telescope Deferred payments can be arranged

THE latest addition to the valuable series of catalogues of Messrs Bernard Quaritch, Ltd, 11 Grafton Street, W 1, is No 426, which deals with upwards of 1600 works classified under the headings of botany, agriculture, early medicine and surgery, forestry, fruit culture, gardens and gardening herbals, modern medicine, and tobacco Many of the volumes offered for sale are rare

APPLICATIONS are invited for the following appointments on or before the dates mentioned —A principal of the Birmingham Central Technical College—The Chief Education Officer, Education Office, Margaret Street, Birmingham (July 1) A temporary lecturer in physics at the Birmingham Central Technical College—The Principal, Central Technical College Birmingham (July 1) An assistant in geography at the London School of Economics and Political Science—The Secretary, London School of Economics, Houghton Street, W C 2 (July 1) A demonstrator in botany—The Secretary, King s College, Strand W C 2 (July 2) An assistant lecturer (woman) in the Department of Education—The Secretary, King s College, Strand, W C 2 (July 2) A junior forestry inspector under the Department of Agriculture—The Secretary, Civil Service Commission, 45 Upper O'Connell Street, Dublin (July 3) A resident lecturer (man) in geography and mathematics—The Principal, Normal College, Bangor (July 3) A chief instructor in the Engineering (Production) Department of the Wolverhampton and Staffordshire Technical College—Clerk to the Governors Education Office North Street, Wolverhampton (July 4) A research student in experimental physics—The Registrar Trinity College Dublin (July 5) A professor of geology at the University of Glasgow—The Secretary of the University Court University, Glasgow An assistant lecturer in biology, who will lecture in botany and a part time demonstrator in biology—The Warden and Secretary London (Royal Free Hospital) School of Medicine for Women, 8 Hunter Street W C 1 A civilian education officer Grade III, at the Royal Air Force Electrical and Wireless School—The Secretary Air Ministry Gwydyr House, Whitehall, S W 1 A full time lecturer in modern languages (French and German) at the Royal Technical College, Salford—Secretary for Education Education Office, Chapel Street Salford A principal of the Kenrick Technical College—Director of Education Education Offices Highfields West Bromwich A lecturer in biology and mathematics at the Bishop Otter College — The Principal Bishop Otter College Chichester An assistant with experience of biological and physical apparatus for sales department—Messrs Griffin and Tatlock Ltd Kemble Street, W C 2

Our Astronomical Column.

THE DISINTEGRATION OF COMETS —Mr N T Bobrovnikoff contributes an important study on this subject to *Lick Observatory Bulletin* No 408 He has prepared statistics on all the comets for which good determinations of magnitude are available they are 94 in number There is shown to be a strong correlation between brightness and period, those of short period being less luminous It is assumed as a working hypothesis that all comets came into existence at the same time, and that those of shorter period, having approached the sun more frequently, have suffered greater disintegration It is found that the comets of extremely small perihelion distance do not conform to the regression line given by the other comets, which is tolerably straight It is concluded that some special action such as partial evaporation of the nuclei, comes into play at these small distances It also appears from the statistics that the proportion of light due to the nucleus alone is greater for the comets of short period, indicating that these have lost a larger proportion of their gaseous envelopes

The indicated rate of loss leads to the conclusion that comets cannot be original members of the solar system, the age of which is estimated at thousands of millions of years Mr Bobrovnikoff estimates their age at about a million years, and concludes that they were all introduced into the solar system at the same time He endorses a conjecture which F Nolke put forward in 1909 that comets were introduced into the solar system at a time when the sun was passing through a nebulous region in space There are great difficulties in seeing how they could fail to describe hyperbolic orbits in this case Friction with the surrounding nebula could not be invoked, for all adjacent regions of the nebula would have the same acceleration towards the sun Nor could resisting medium in the solar system be invoked, as a million years is so small a fraction of the age of the solar system that the density of such a medium would not be appreciably greater then than now The number of close approaches to planets would be far too small to explain the great host of comets

However every attempt to explain the origin of comets is accompanied by grave difficulties The present paper undoubtedly establishes some important points and advances our knowledge on the subject even if we hesitate to accept all its conclusions

STELLAR PARALLAXES WITH THE YALE TELESCOPE AT JOHANNESBURG —Dr H L Alden, who with Mr O Connell is conducting the photographic determination of stellar parallaxes at Johannesburg, publishes his first list of fifty stars in *Astro Jour*, No 921 It is satisfactory to note that the parallax found for Alpha Centauri, which is 0 755" for the mean of the components, is in almost perfect accord with Gill and Elkin s value obtained with the Cape heliometer That for Proxima Centauri is 0 783", as this exceeds the value for Alpha in nearly the same ratio as the proper motion does it confirms the conclusion that Proxima belongs to the Alpha Centauri system

After this system, our next nearest neighbour is the Barnard star, for which Alden gives the parallax 0 555" The next largest parallax on the present list is that of Epsilon Indi 0 286", the parallax of this star was previously regarded as rather uncertain, so the new determination is welcome There are on the list two other stars the distance of which is less than five parsecs, these are 70 Ophiuchi, parallax 0 209", and Omicron 2 Eridani, 0 200"

All the parallaxes are relative, and need to be increased by about 0 005" to reduce to absolute values The negative value − 0 005" was found for Alpha Orionis, this confirms the fact of its great distance and huge size The number of plates used for each star varies from 15 to 23, the average probable error of a parallax is 0 0068"

Research Items

MAGIC IN BENGAL —The *Indian Antiquary* for April and May contains a study on magic in Bengal by Dr Biren Bonnerjea Magic was largely practised by the ancient Hindus and survives to a considerable extent among the modern inhabitants of Bengal Iron is one of the principal weapons against evil spirits They will not touch anyone who has any thing of iron or steel on them and a married woman is safe from them because of her bangle of iron which is usually covered with gold A pair of betel cutters is kept under the pillow of a sleeping child and when a woman dies in child birth a nail or piece of iron is hidden in the folds of her dress so that her spirit may not return and take away her child A traveller may contract dangerous infection from strangers hence anyone returning from say Europe must be purified by the ceremony known as Prayaścitta consisting in the polling of the hair and eating or at least touching with the lips of cowdung Ambassadors of native princes on returning from England have been considered so polluted as to require to be re born In Chittagong at a difficult child birth the doors must be thrown open corks taken from bottles and dogs and other animals set free Amulets made of the teeth and claws of tigers and crocodiles are worn because these are the most dangerous of the animals of Bengal To ensure the health and well being of a child during the coming year water is poured over it on its birth day through a sieve which contains ten different kinds of flowers and leaves and bits of gold or silver Many of the simple acts of life have peculiar rituals of their own For example a woman who cleans out her ears after nightfall runs the risk of bodily injury but she may do it with impunity if she asks the permission of anyone present If she is alone she asks permission of the wall A precaution against the dangers attendant on the common acts of life is to snap the thumb and middle finger of the right hand

EDENTATES OF ARGENTINA —The University of Buenos Aires has published a monograph on Los Edentata Argentinos submitted by José Yepes for the degree of Doctor en Ciencias Naturales (*Revista Univ Buenos Aires* Ser 2 Section 5) The work which contains short descriptions and summaries of the distribution within the Argentine and beyond it and full synonymies is well illustrated and forms a handy guide for the identification of the various forms Several of the species of the South American edentates have developed well marked geographical races so that the number of forms of this odd group now distinguished in the neotropical region numbers sixty eight Many of these are wide spread so that Argentina contains in all nineteen forms, of which only six are peculiar to it The most outstanding of these since they represent distinctive genera are *Chlamyphorus truncatus* and *Zaëdyus pichiy* but *Chætophractus*, all the four forms of which occur in the Argentine is also a genus of restricted distribution confined to that republic and Bolivia

EMBRYONIC MORTALITY IN FOWLS —Even under the best conditions the poultry farmer suffers a considerable loss from mortality among embryos during incubation Mr F B Hutt and Dr A W Greenwood have made an investigation into the causes of such mortality and have examined more than 12 000 eggs which failed to hatch during incubation (*Proc Roy Soc Edin* vol 49 Pt 2, 1929) They find that one of the major causes of failure to hatch is the malposition of the embryo in the shell Four main malpositions are described One of these, in which the head is buried between the legs definitely prevents the embryo from chipping the shell and so hatching The other three by preventing access to the air chamber of the shell hinder pulmonary respiration and so suffocate the embryo A further cause of embryonic mortality is the abnormality known as chondrodystrophy The occurrence of this abnormality is independent of the breed of fowl sex of embryo and age of dam Its incidence is highest in January and February and declines steadily to almost complete absence in June The incidence is inversely proportional to the amount of sunshine and it is suggested that lack of direct sunshine is a factor in the etiology of the abnormality There is a suggestion that the causal agency is an hereditary physiological abnormality in the dam A further percentage of the embryos in the eggs which failed to hatch were actual monstrosities The various types are described and their frequency noted There is a decline in the incidence of monstrosities from February to June Ninety three per cent of the monstrosities were characterised by various degrees of abnormality either in the brain cranium or eyes or in the combinations of these organs It is suggested that monstrosities are caused by the arrest of the development of the embryo at a critical stage probably by the chilling of those eggs laid in the early stages of gastrulation

PHYSIOLOGY OF THE EMBRYONIC DEVELOPMENT OF EARTHWORMS —While there is a considerable literature on the morphological side of development of Oligochæta the physiological processes of the development have never been studied and a recent paper by P G Svetlov (*Travaux du laboratoire zoologique et de la Station zoologique de Sébastopol* Académie des Sciences Leningrad Série 2 No 13 1928) contains much of interest in this respect while the morphology of embryonic development is also treated very fully Of particular interest are the observations made by the author on the osmotic pressure of the fluid in the cocoons of the two species studied It was found that in *Bimastus constrictus* Rosa the osmotic pressure is very low, while in *Eisenia fœtida* Sav it is almost as high as in the blood of adult worms Osmotic pressure in the cocoons of both species is closely connected with that of the environment that is that of the soil water this necessitates the presence in *B constrictus* of a special apparatus for regulating the osmosis (osmo regulating blastomeres), in the case of *Eisenia fœtida* this apparatus undergoes a reduction because this species has a high osmotic pressure little influenced by the external conditions On the whole, however the embryos of both species are not particularly well adapted to the osmotic conditions of their environment The importance for ecological studies of the osmotic relations between cocoons of earthworms and the environment is strongly emphasised by these observations

GERMINATION AND VIABILITY OF FERN SPORES —Whilst studies of seed viability and the effect of external conditions on seed germination abound, similar studies upon the unicellular spores of ferns are much less numerous although such studies may throw considerable light upon the physiological problems connected with the maintenance of viability and conditions for germination, etc The very extensive studies by F Okada, described in the *Science Reports* of the Tôhoku Imperial University, Vol 4, No 1, series 4 of the germination of the spores of five species of ferns and the retention of viability

under different conditions are, therefore, particularly welcome Okada finds that the spores of *Equisetum*, which rapidly lose viability under almost any conditions of storage (10 24 days under laboratory conditions), contain nearly 50 per cent water on fresh weight, whilst the much more durable spores of *Woodwardia* (174 191 days under laboratory conditions) contain only about 6 per cent water The spores of several species of ferns failed entirely to germinate in complete darkness, the spores of *Equisetum arvense* and *Osmunda japonica* would grow under these conditions The catalase content of the spores was examined and in every case it diminished with increasing age

YEAST FROM A THEBAN TOMB —The principal feature of the current Jahrbuch " of the Gesellschaft fur die Geschichte und Bibliographie des Brauwesens, E V (Institut fur Gärungsgewerbe, Berlin) is an article by Prof J Gruss on the contents of a beer jar from the tomb of Wah a Pharaoh of the eleventh dynasty Mr H E Winlock, the leader of the expedition from the Metropolitan Museum of Art, New York, which opened the tomb in 1920 considers that although the jar was found on its side, it was probably upset when the stopper blew off, and the contents are therefore almost certainly 4000 years old The microscopic examination is illustrated by twelve plates, and revealed diatoms probably from the Nile water aluminium silicate crystals from the pottery, cloth fibres starch grains, and fragments of emmer Bacilli, pediococci, diplococci, and citromycelia were also found, and in addition an autogenic yeast similar to Digora, which Prof Gruss has named *Saccharomyces Winlocki* It is distinguished by elliptical or round cells 5 μ in diameter and has a close grained plasma and nuclear vacuole The yeast was also found with *Schizomyces ducens n spec* and aleurone cells in pieces of beer loaf from the same tomb, and it is noteworthy that these pieces are contemporaneous with bread in the Berlin museum found in the tomb of Mentuhotep in the same cemetery The chemical analysis of the loaf indicates the addition of honey for sweetening purposes and of a fruit of the *Citrus Aurantium* type to produce bitterness The same publication also contains several interesting articles on the medieval monastic breweries of Germany, and a note by F Schuster on the 'ferula', a carved wooden sceptre which was formerly the symbol of the skilled brewer in Germany Apparently the name is derived from the plant *Ferula L*, a variety of fennel, the stalk of which figured in Bacchus worship (Narthex), and therefore had a special significance for the brewer

VOLUME TABLES FOR INDIAN TIMBER —It is only during the present century that the preparation of growth and volume statistics has been commenced in the forests of the British Empire, and its inauguration was due to the Indian Forest Service Statistics of the kind are now available for some of the more important timber species of India and Burma, such as deodar, sal, and teak In a recent number of the *Indian Forest Records* (vol 13, Pt 3, Sylviculture Series, 1928) commercial volume tables for sal (*Shorea robusta*) in the wet mixed forests of the Bengal Duars are published Several volume tables for this species are already in existence, but they relate chiefly to the growth of this tree in the drier climate of the United Provinces The latter tables, it is considered, can be safely applied to the drier types of Bengal sal forest, as also to similar forest in Assam They are inapplicable, however, to the moist type and it is for this latter that the new tables are designed The preparation of such tables involves considerable field work in connexion with the measurement of the crops on selected areas of forest, work in which the compiler, Mr Parma Nand Suri, statistical assistant to the sylviculturist of the Research Institute, was ably assisted by the local forest staff The same officer has also prepared (*Indian Forest Records*, vol 13, Pt 4, 1928) a set of tables the first of their kind, for the sundri (*Heritiera Fomes*) in the Sundarbans, the Gangetic delta south of Calcutta These tables have been drawn up for the two types of sundri forest, the salt water type and the fresh water type They should prove of great assistance in estimating the outturn of coupes and volume of growing stock In connexion with the Sundarbans sundri volume tables, Mr H G Champion, sylviculturist at the Research Institute writes in a preface Since the work was begun there has been published *Burma Forest Bulletin* No 15 (December 1926), a quarter girth volume out turn table for this species, for the Delta division of Burma There is a very fair agreement in the small overlapping portion suggesting that if larger trees are grown in the Sundarbans the Burma figures may prove useful Both pamphlets are illustrated and furnish evidence of the great strides made in the scientific aspects of forest work in India

PROGRESS OF SURVEYING IN INDIA —The Report for 1925–26 of the geodetic branch of the Survey of India, which is dated July 1928, has a record of much work Geodetic triangulation was resumed with work in Lower Burma, after an interval of eight years Previous work in that area dated from 1875 High precision levelling occupied several detachments Tidal observations with automatic gauges were continued at eight ports There are now more than fifty stations in Indian waters, including the Persian Gulf and Red Sea, at which automatic tidal observations have been taken for a number of years Among other interesting matters on which the report touches is the value of bench marks on trees In Canada such bench marks have been used Their constancy has not been tested with any permanent mark of the land established in precise levelling, but the topographical survey does not disfavour their use At Dehra Dun experiments have been made on tree bench marks and eleven of them have been connected at intervals, during twelve years, with the standard bench mark in the Geodetic Office grounds The conclusions of those tests are that for secondary precision, as in irrigation work, a tree bench mark is sufficiently good, but is not constant enough for lines of high precision In all cases the mark should be placed on the heart wood and not on the bark of the tree

OIL AND GAS IN WESTERN CANADA —The economics of the Canadian oil industry have changed much since the two well known volumes on petroleum and natural gas in the Dominion, by F G Clapp, were published in 1914–15 Then it was the eastern provinces which were mainly responsible for production, especially Ontario With the gradual decline of these eastern fields, however, attention is naturally being concentrated on the more westerly developments, and the performance of " Royalite No 4 " well in the Turner Valley Oilfield, Alberta, 1924, which raised this province to the leading position of production in the Dominion, a position since maintained, has naturally had a strong influence in reviving interest in this region Alberta has always swayed popular feeling, equally scientific interest, by its famous gas fields, but search for large oil pools has not often proved encouraging, save the instance cited It is characteristic that new possibilities of oilfield development in the western hemisphere should be the occasion of renewed literary activity, so that the bulletin now appearing under the above title from the pen of

G. S. Hume (Department of Mines, Canada) has for some time been anticipated by oil technologists. It is also characteristic that such bulletins should include what we may term 'chapters of instruction for the uninitiated', a kind of condensed text-book outlining the general features of oil origin, occurrence, accumulation, structures, and so on, much as occurs in the previous volumes cited. A modern note in this 'text' is struck by a chapter on geophysical methods for locating oil, but it is doubtful whether this outline would do more than confirm an inexperienced operator in the opinion that the subject was far beyond his (the operator's) comprehension; technically, such a chapter is too brief and sketchy to be of any value. The descriptions of the oil and gas fields of the western provinces are more to the point, though unnecessarily burdened with detailed well logs. The maps and sections given are, however, most valuable, and the description of the Turner Valley field particularly good.

QUANTISED TRANSITIONS.—In the correlation of the terms of line spectra with the stationary states of atoms, considerable use is made of a number of quantum rules that express the possibility and the probability of various types of transitions. A generalisation of the theory upon which these are based has been made by J. A. Gaunt in a paper in the May issue of the *Proceedings of the Royal Society* on the relativistic theory of an atom with many electrons. He finds that the selection rules are valid if there are no external fields; the rule '$\Delta\Sigma k$ is odd' is equally rigorous even in a uniform magnetic field, and that the summation rule for the intensities in a multiplet is true to a first approximation. The greater part of Mr. Gaunt's paper is of a general nature, but one practical point to which he refers specifically is of some significance in astrophysics. Certain lines of nebular spectra have been attributed to forbidden transitions between stationary states of the doubly charged ion of atomic oxygen; if they have been correctly identified, it would seem that their emission must occur in an electric field or in a non-uniform magnetic field, since they have $\Delta\Sigma k$ equal to zero.

REFLECTION CAUSTICS.—A note in the *Transactions of the Optical Society* (vol. 30, p. 134) from the Optics Department of the National Physical Laboratory contains an interesting set of photographs of reflection caustics which were obtained by the double reflection of light within a photographic lens. The reproductions, in spite of the fact that they do not show all the finer details of the original, include a number of beautiful patterns, mostly built up of various elliptical and cusped curves, and are of considerable interest as illustrations of an aberration which is not often encountered now in optical instruments. The usual absence of this effect, it is suggested by the authors, Messrs. T. Smith, J. S. Anderson, and L. C. Cordle—is possibly due to the fact that the main interest is now centred in systems so well corrected that faults of this type are masked by diffraction, and the caustics only reappear when the lens is used under conditions different from those for which it was designed. The same issue of the *Transactions* contains a pair of coloured reproductions of the appearance presented by a test bar when examined in plane polarised light and in circularly polarised light in the Coker strain testing apparatus, which are also of considerable educational value.

MAGNETOSTRICTION.—The phenomena of magnetostriction are anomalous in that, in spite of the way in which they are observed, they are far too large to be explained by purely magnetic forces. The corresponding difficulty which arises in connexion with Weiss's molecular fields in iron and similar bodies has recently been removed by Heisenberg's theory of ferromagnetism, which is based upon the 'exchange' properties of electrons, and it has now been shown by R. H. Fowler and P. Kapitza that the same theory can be extended with very little elaboration to include all the essential facts of magnetostriction and the phenomena of the Curie point. One striking feature of their paper on this subject in the issue of the *Proceedings of the Royal Society* for May 2 is the scarcity of accurate experimental data by which the theory—in itself still far from complete—can be tested. So far as magnetostriction is concerned, experiment does appear to be well ahead of theory, but the measurements of the allied change in the size of specimens when they lose their intrinsic magnetisation at the Curie temperature are particularly unsatisfactory. The experimental values for the changes in the specific heat at the Curie point are also perhaps uncertain, although they do suffice to show that nickel has probably one magnetisable electron per atom, whilst iron and magnetite have two or three effective electrons, the latter both being cases for which the quantum analysis has still to be constructed. Heisenberg's theory will require to be considerably extended before it can account for all the complex features of ferromagnetism, but it has certainly already removed the subject from its previous somewhat isolated position, and has at the same time emphasised the need for further experiment and indicated the lines upon which it should be attempted.

SOME PHYSIOLOGICO-OPTICAL EXPERIMENTS.—Prof. Bohuslav Brauner has recently communicated to the Bohemian Academy of Sciences a paper describing some remarkable physiologico-optical experiments which he first made fifty-five years ago under the inspiration of Helmholtz. He afterwards discussed them with the late Prof. Deyl, a prominent Central European ophthalmist, who was impressed by their novel character, and as they have never been published, Prof. Brauner was persuaded to lay them before the Bohemian Academy. The first to be described relates to artificial blindness, which can be induced by throwing the image of a well-illuminated body upon the blind spot of the retina. Thus, when the image of the moon is projected upon the blind spot, total blindness results in a few seconds. Other remarkable experiments concern the visibility of the observer's eye and stereoscopic results without the use of a stereoscope (results acquired after some practice in making the axes of the eyes parallel or crossed as circumstance and effect demand). In this connexion one of the experiments described is an amplification of an observation by Pouvilliers (see NATURE, April 14, 1923, p. 511). It appears that when two identical contour maps placed side by side with their centres 62 mm. apart were observed with the axes of the eyes nearly parallel, a double superposed picture much larger than the originals is observed in the middle, apparently below the level of the paper. The mountains stand out higher according to their contours, so that a relief map is obtained. When viewed with crossed axes, the combined picture is apparently much smaller than the originals, both of which are here pushed farther apart and appear relatively larger. In this instance the summits of the mountains appear as funnel-shaped depressions. It would seem that some of the effects obtained by Prof. Brauner can be explained by the fact that the accommodation of the eyes changes automatically with the change of the angle of the ocular axes.

South Africa Meeting of the British Association

PROGRAMMES OF SECTIONS

MATHEMATICS AND PHYSICS

AT the forthcoming South Africa meeting, Section A (Mathematics and Physics) will be under the presidency of the Right Hon Lord Rayleigh Representatives from Great Britain of all branches of the Section will support him and will communicate papers in the two centres of the meeting, Cape Town and Johannesburg Prof Hevesy, who is a foreign guest, will open a joint discussion with the Section of Chemistry on quantitative chemical analysis by X rays and its applications, and a second joint meeting, in this case with the Section of Geography, will be held for a series of papers on geodesy and surveying Recent work on atomic nuclei will be described by Sir Ernest Rutherford and Dr Aston, and spectroscopic papers presented by Prof McLennan, Prof A Fowler, Mr R H Fowler, and Mr A C Menzies Some aspects of the work of the National Physical Laboratory, to be dealt with by Dr Ezer Griffiths, should bring to the notice of South Africans the important part played by the Laboratory in the scientific and industrial life of Great Britain In Cape Town itself, some interesting communications are expected from Prof Ogg and his colleagues in the University of Cape Town

Cosmical physics, already strongly represented in South Africa itself, will receive the aid of Prof de Sitter as a foreign guest, the Astronomer Royal, Prof Eddington and Prof Chapman Lastly, the claims of mathematics will be met by papers from Sir Gilbert Walker, Mr F P White, and Dr Wrinch

CHEMISTRY

THE address of Prof G Barger as president of Section B (Chemistry), will be delivered at Cape Town, and is entitled "Applications of Organic Chemistry to Biology" Organic and biochemical subjects occupy the major portion of the Cape Town programme Prof K Freudenberg, of Heidelberg, will give a lecture on 'The Vegetable Tannins", a subject of special interest in South Africa, and it is hoped to hear an account of "Essential Oils from South African Plants" by Prof St J van der Riet, of Stellenbosch Although the nature of vitamins from the chemical point of view was discussed so recently as the Leeds (1927) meeting, the rapid development of our knowledge of the vitamins since that time makes the joint discussion with Section I (Physiology) particularly opportune On the one day at Cape Town devoted to general and inorganic chemistry, Dr N V Sidgwick will give a lecture on "Chemical Linkage" and Prof J Smeath Thomas, of Cape Town, will give an account of "Recently discovered Nitrate Deposits in S W Africa" From Cape Town it is hoped that the Section will have the privilege of visiting the factory of The Cape Explosives Co at Somerset West

The sectional programme at Johannesburg is to be devoted almost entirely to inorganic and physical chemistry Mr H A White, of the Geduld Proprietary Gold Mines, Ltd, is to give an account of "The Chemistry of Gold Extraction", and two special features of the Johannesburg programme are a joint discussion with Section A (Physics) on "Qualitative Analysis by X rays" to be opened by Prof G Hevesy, of Freiburg, and a lecture by Prof E C Franklin, of Stamford University, California, on "The Ammonia System of Compounds" Mr A C Egerton is to give an account of "The Influence of Antiknocks on the Combustion of Hydrocarbons", and other important contributions to the programme are being made by Prof H Bassett and Dr F H Constable

GEOLOGY

THE organisation of Section C (Geology) has been necessarily affected by the meeting of the International Geological Congress at Pretoria, and a programme has been adopted which, while enabling the section to carry on its work with the Association, yet allows its members to take some part in the proceedings of the Congress Two sessions will be held at Cape Town and two at Johannesburg Members of the Congress who wish to be present and take part in the proceedings at Johannesburg will be able to take advantage of the invitation which has been extended to them

Sir Albert E Kitson, of the Geological Survey of the Gold Coast, president of Section C, will deliver his address at Johannesburg on "The Utility of Geological Surveys to Colonies and Protectorates of the British Empire"

The special position that Africa takes in all questions involving continental drift makes the joint discussion with Sections D (Zoology) and K (Botany) specially appropriate Phases of the problem may be touched in the papers by Prof W T Gordon on "Some Limestone Erratics from the Beardmore Glacier", and Mr W N Edwards on "Triassic Rhætic Floras of the Southern Hemisphere" Dr F Dixey will describe the geology of the Lower Shire Zambezi Basin and Mr F P Mennell will put forward "Some Suggestions as to the Origin of the Diamond Pipes" Of wider interest is the paper of Prof P G H Boswell on "The Precipitating Action of Colloids on Fine grained Sediments" this opens a new field of investigation

As is usual with Section C, the excursions are a feature of the programme As these have been arranged by Dr A L Hall, of the Union Geological Survey, and secretary of the International Geological Congress their interest and importance is assured Two half day and one whole day excursion will be made in the neighbourhood of Cape Town The journey from Cape Town to Johannesburg will be spread over four days with stops at Laingsburg and Kimberley Between the two sessions at Johannesburg members will be able to join the Congress for the Witwatersrand excursion (three days)

GEOGRAPHY

THE president of Section E (Geography) for the South Africa meeting is Brigadier F M Jack, Director General of the Ordnance Survey, who will deal with "National Surveys" in his presidential address Following this a series of papers will be read by Capt McCaw, Dr Van der Sterr, and others, dealing in further detail with cartographical and survey problems relating to Africa in general, and to South Africa in particular In connexion with these, it may be recalled that at the Glasgow meeting the Section emphasised the importance of completing as soon as possible, the survey of the arc of the thirtieth meridian, and urged also the need for the publication of a uniform series of maps of Africa on a scale of 1 2,000,000, as the only satisfactory base for various distributional studies in Africa The significance of the latter will be further developed, along with other points, in a report to be presented by Mr A G Ogilvie of a special committee which has been investigating problems connected with the geography of tropical Africa

Various aspects of South African geography—both physical and human—will be analysed, both at Cape Town and Johannesburg, by local authorities, including Prof J H Wellington and Prof E Walker At Cape Town, Mr Van Reenen, chairman of the

Irrigation Commission, will review various problems connected with the utilisation of available water supplies in South Africa, while Prof Serton will examine critically the extent to which the term 'desert' may be justifiably applied to various regions of low rainfall (for example, the Western Karroo, with an average annual rainfall of less than 5 inches in parts)

A meeting in a region of winter rains such as south western Cape Colony provides a fitting opportunity for a critical survey of "the Mediterranean Climatic Type, its World Distribution and the Human Response", which Dr Marion Newbigin proposes to undertake The various important problems connected with the South African sector of Antarctica will also be presented in a paper prepared by Mr F Debenham, and it is hoped that General Smuts will take part in the discussion on the matters raised

The position of geography in South African education is not all that can be desired, and attention will be directed to this important aspect in a joint discussion that has been arranged with Section L at Johannesburg, a whole morning being devoted to the question

Outside of Africa various interesting papers are being presented dealing with parts of both the southern and northern hemispheres The significance of China's expansion in the Far East is to be considered by Prof P M Roxby, while among the papers on Europe will be one by Prof H J Fleure analysing the significance of various city types in the interpretation of the different cultural regions of the Continent

Dr Vaughan Cornish's interest in the æsthetics of scenery is now well known in Great Britain and a paper by him on "The Rural Scenery of England and Wales" will be welcomed in South Africa

ECONOMIC SCIENCE AND STATISTICS

THE programme for Section F (Economic Science and Statistics) of the British Association has now been arranged for the forthcoming meeting in South Africa, and, as was to be expected, special attention is to be devoted to those economic problems which are of importance in the Union Labour questions, for example, are to be discussed in the light of South African conditions, and for this purpose a joint discussion has been arranged with the Anthropological Section on "Economic Competition between Advanced and Backward Peoples", while Prof A Leslie is to speak on "Coloured Labour and Trade Unionism in Cape Town" Another economic topic of considerable importance to South Africa is the marketing of agricultural produce and the joint meeting which has been arranged with the agriculturalists on "The Problem of Stabilising Agricultural Prices, with special reference to Control Boards, Equalisation Funds, and other methods of Price Regulation", should lead to an interesting discussion It is anticipated that Mr R B Forrester, Dr Tinley, and Mr R J Thompson will participate in this discussion At Johannesburg, Dr J E Holloway is to speak on "Population Problems of South Africa", while Mr W H Clegg will describe "South African Banking"

ENGINEERING

ENGINEERS attending the South Africa meeting of the British Association will have papers and discussions at both Cape Town and Johannesburg The president of Section G (Engineering), Prof F C Lea, will deliver his address at Johannesburg

The principal subjects chosen for papers are of great importance to South Africa At Cape Town Dr Ezer Griffiths, of the National Physical Laboratory, and Mr E A Griffiths, of Cape Town, will give papers on recent research work carried out in England and South Africa in refrigeration The successful export of fruit from the Union depends largely on this work

The importance of transport, which is as great in South Africa as in any other country, will be dealt with from many different angles by English and South African authorities Sir Henry Maybury will describe the developments which have taken place in Great Britain during the past few years, referring to the effect of recent legislation on road administration Papers dealing with transport costs, alcohol fuels, railways, and roads as feeders to the railways will also be given Sir Henry Fowler's paper will describe chiefly the work of the Directing Committee, of which he is a member, appointed by the British Government to study aspects of mechanical transport likely to further the economic development of the overseas Empire and it is hoped that the discussions on these papers will be of great help to this committee

At Johannesburg cheap power will be dealt with Sir Charles Parsons will give a description of the more recent developments in steam turbine practice, chiefly in regard to the increased output per unit

Prof E W Marchant's paper on the limits of the economical transmission of electrical energy will have an added interest, for at the last South Africa meeting of the Association the late Prof Ayrton made an important contribution on the transmission of power from the Victoria Falls Mr C H Merz will describe the development of the national scheme of electricity supply in Great Britain, and discuss the anticipated economies and the probable effects of the cheapening of electric power on the distribution of population and industries

The acute problem in mining in South Africa is the cooling and ventilation of the deep mines, and the joint discussion of the Engineering and Physiological Sections on deep mine ventilation, to take place at Johannesburg, should prove very valuable

ANTHROPOLOGY

SOUTH African anthropologists have prepared a full and interesting programme for Section H (Anthropology), in which archæology figures largely There is ample evidence, however, that other branches of the science are not neglected in the Dominion, and it has been necessary to make arrangements for a subsection at Johannesburg to provide for a number of papers on physical anthropology by Prof Dart and other members of the Anthropological School which centres in the University of the Witwatersrand At Cape Town especial interest will attach to a series of papers on the Fish Hoek Caves, which will be followed by a visit to the caves themselves The meeting at Cape Town will, however, be curtailed to allow the members of the Section to proceed in advance of the main body to Kimberley, where the collection of skulls and archæological exhibits in the Museum will be visited, Mr Cronin's remarkable collection of photographs of South African natives will be viewed, and archæological excursions in the neighbourhood will be made

The programme at Johannesburg will be particularly interesting Prof Dart will exhibit the Taungs skull, and arrangements have been made for a visit to the site of discovery Mr Leakey will describe his discoveries in the prehistory of East Africa, and Mr. Wayland will deal with the present position of Stone Age research in Uganda Mr C von Riet Lowe will deal with the archæology of Sheppard Island, with an addendum on the associated fauna, and Prof. Dart will describe mammoths and other fossil elephants of the Transvaal, some of them not previously known.

The question of Bushman rock engravings will be discussed by Miss Wilman, a subject on which much illuminating discussion may be expected, in view of

the visit of L'Abbé Breuil to South Africa as a guest of the Association and the demonstration of the Late Palæolithic art of Spain which he will give at Cape Town Members of the party proceeding from England—Prof Fleure Prof Ruggles Gates, Miss Murray, and others—will contribute to the pro ceedings

The items in the sectional programme however, which are expected to arouse the keenest interest are the papers centring around Zimbabwe Dr Leo Frobenius will give an account of the explorations of prehistoric Rhodesia made to date by the expedition of which he is leader He will be followed by Miss Caton Thompson who will describe the results of the work undertaken at the request of the Association which she has carried out at Great Zimbabwe and on which she has been engaged since the beginning of the year on behalf of the Association

PHYSIOLOGY

SECTION I (Physiology) this year includes in its programme one or two unusual items Probably the most striking is a joint discussion with the other biological sections on The Nature of Life ', which General J S Smuts has promised to open Among the other speakers on this topic are Profs D'Arcy Thompson, J S Haldane, Wildon Carr, and E C C Baly That an agreement will be reached is more than can be expected, but it is certain that much of interest will be said

The Capetown part of the programme also includes joint meetings with Section D on experimental biology, one morning being mainly occupied by papers on this subject, and an afternoon being devoted to de monstrations on kindred topics in Prof Lancelot Hogben s new laboratory Many of the contributions, both here and at Johannesburg are from South African workers, and the matters discussed range over a wide field

At Johannesburg the most important feature prob ably is a joint discussion with Section G (Engineering) on Problems connected with Deep mine Ventila tion ' The economic importance of this matter is very considerable, and it is hoped that members of the Transvaal Mining and Metallurgical Society will also be able to participate

Of almost equal interest to physiologists and to economists is "The Problem of Dust Inhalation", on which also a discussion has been arranged The sectional programme is now, however, restricted to questions connected with the mining industry Papers are being contributed by local workers on the measure ment and effects of ultra violet light, and a varied programme includes a paper by Dr Monckton Cope man on "Diet and Cancer", and a description of "The Feeding Habits of Vampyrella", with kinemato graph accompaniment, by Prof F E Lloyd, of McGill University

PSYCHOLOGY

SECTION J (Psychology) meets this year under the presidency of Mr F C Bartlett, the Director of the Cambridge Psychological Laboratory, who in his address will discuss 'Experimental Method in Psychology" The programme is full and varied, in it nearly every department of psychology is repre sented A joint discussion has been arranged with Section L on "Psychological Tests in Relation to Education and Vocational Guidance" in which papers will be read by Prof Reyburn, Dr C S Myers, and Dr Shepherd Dawson

South African psychologists will present seven or eight papers, three of which, by Prof Wilcocks, Prof E[illegible]rs, and Dr Fick, will report the results of investi gations into the intelligence of South African children both white and black The philosophical aspects of psychology are represented by Prof G Dawes Hicks in a paper on The Notion of Fusion in Psychology by Prof H Wildon Carr, who will speak on Imagina tion and Reasoning and by Prof Forsyth of Bloem fontein who will read a paper on the Significance of Holism , a philosophical theory propounded by General Smuts

The Industrial Fatigue Research Board is repre sented by Mr Eric Farmer, who will give an account of some of his own work on accident proneness

BOTANY

SECTION K (Botany) has a very full programme both at Cape Town and at Johannesburg The large number of papers to be communicated by South African workers indicates clearly the very active interest which is being taken there in botany at the present time All branches of botany are well repre sented in the programme Prof Seward s presidential address on Botanical Records of the Rocks will be given at Johannesburg As might be expected much time will be devoted to papers on the South African flora and there will be a discussion on its origin and evolution in which Dr Marloth Prof Bews Prof Compton Dr Pole Evans Prof Adamson Prof Moss, and others will take part Dr Pole Evans will also give an account of the present position of the botani cal survey of South Africa Prof F E Lloyd will exhibit a film illustrating the mechanism of the trap of *Utricularia* and Dr A S Hitchcock of the Smithsonian Institution will speak on the subject of grasses in relation to man Miss Saunders will discuss her recent work on carpel morphology

Popular lectures will be given by Dr Margery Knight on Seaweeds, a Study of Adaptation and Opportunity , and by Prof Priestley on From Lake to Veld a Study of the Water Relations of the Higher Plant The forestry group also has an interesting programme in which contributions from persons interested in forestry problems in South Africa are prominent Numerous excursions to places of botanical interest have been arranged

EDUCATION

THE programme of Section L (Educational Science) is promising and varied Two objects have been kept in mind in its preparation (a) the desirability of showing the recent development in educational ad ministration, practice, and teaching in England, and (b) the presentation and discussion of South African problems

Dr Kimmins has chosen for his presidential address the subject Modern Movements in Education ' One session at Cape Town is to be devoted to general educational problems in South Africa when five separate papers will be given by leading experts

At Johannesburg a full session will be devoted to 'Education and the Native Races , four papers being expected At a joint session with Section J at Cape Town, leading psychologists from both countries will discuss psychological tests in relation to education and vocational guidance Other sessions at Cape Town will be given to discussions on the relation of examinations to the secondary schools and on the teaching of science, including biology and botany, in schools At Johannesburg, at a joint session with Section E, papers will be given on the teaching of geography by members from both countries

Committees of the Section will also present reports on science in the school certificate, formal training and training for life overseas

AGRICULTURE

PERHAPS the most significant development which has taken place in agricultural science is the realisation of the very close relationship between soil and animal nutrition problems as they exist in Great Britain and the various Dominions of the Empire.

The fact that much of the work in progress in the British Isles has a direct bearing on Dominion problems has resulted in a desire for closer touch and collaboration between research workers in various parts of the Empire. This trend was emphasised and focused at the Imperial Agricultural Conference in London in 1927 and practical recognition has been given by the creation in the British Isles of Agricultural Bureaux in Soil Science, Animal Nutrition, Plant Breeding, Animal Genetics, and Veterinary Science. It is fitting, therefore, that by far the greater part of the programme for Section M (Agriculture), which is meeting at Cape Town and Pretoria, should be occupied by the discussion of broad agricultural problems. Two whole sessions are being devoted to soil problems, the first at Cape Town to a discussion on soil fertility and its control, and the second at Pretoria to methods of soil investigations in field and laboratory.

A morning session will be occupied by a discussion on Empire wool growing problems with particular reference to South Africa and to the manufacturing requirements of Great Britain. Grassland and the production of stock is another problem of world wide range, the fundamental aspects of which are similar in all parts of the Empire. Major Walter Elliot will open a discussion on the mineral aspects of pasture nutrition in relation to the live stock industry, and representatives of the Rowett Research Institute, Aberdeen, and the South African Veterinary Research Station will contribute.

The possibility of stabilising agricultural prices and the methods of achieving the object in view continue to exercise the minds of farmers and economists the world over, and considerable experience has been acquired in South Africa, Canada, and New Zealand. Section M has arranged for a joint discussion with Section F (Economics) on this subject, with particular reference to the operation of control boards, equalisation funds and other methods of price regulation. Agriculture and the Empire will form the subject of Sir Robert Greig's presidential address to Section M, and the address, together with a discussion on Empire agricultural problems, will occupy the whole of the second morning session at Pretoria.

Some Function Problems attaching to Convergence[1]

THE arrangement of the conducting paths of the nervous system, branching and redistributing their impulses as they do, exhibits places where numerous convergent paths run into one. When at such places two or more of the converging arcs are concurrently active, the trains of impulses arriving by them can interact. Such convergent places are co-ordination points. An example of much importance, and relatively accessible to experiment, is that in the spinal cord, where the motor nerve cells innervating a muscle receive as a group the various afferent paths which reflexly operate the muscle. If two or more of the convergent afferent nerves are excited concurrently, the reflex interaction, as revealed by the muscle, exhibits three main sets of cases.

In one set of cases the muscular response under concurrent stimulation of two or more afferents shows a deficit in amount as compared with the sum of the responses obtainable from the several afferents taken separately. This occurs especially when the excitation of the reflexes is strong; it is most marked when they are of maximal strength. The contraction effect of one afferent may default altogether. The result might seem to indicate inhibition, but analysis shows that it is not referable to any form of inhibition.

The explanation lies in the limitations of the mechanical response of the muscle fibres of the motor units activated: the contraction effect pertaining to one afferent being 'occluded' for the time being by that pertaining to another. 'Occlusion' is a result of the overlap of different afferent arcs upon the same motor units: this overlap is 'central', for example, in the spinal cord. The amount of 'occlusion' as observed by the myograph gives a measure of the amount of that 'central' overlap. In such estimates, however, the assumption is made that the component motor units of the muscle all of them possess individually the average value of contraction tension which obtains for them. This in the knee flexor (cat) semitendinosus has a value which is only one third of that obtaining for gastrocnemius. It is, however, certain that the individual motor units differ considerably in contraction value within one and the same muscle. Examined by occlusion, the overlap of the constituent branches of a single large afferent nerve upon its motor units can be well above tenfold. This gives a functional picture in harmony with the histological picture furnished long since by Cajal.

In another set of cases, on the contrary, the contraction response of the muscle, under concurrent stimulation of two or more reflex arcs which are excitatory for it, shows a surplus of contraction as compared with the sum of the responses to the component afferents taken separately. This result is most evident with weak reflexes. As with the other set of cases this result also, although opposite to the previous class, brings evidence of the overlap of the convergent arcs upon the central ends of motor units held by them in common. Moreover, evidence is thus furnished that central states of excitement, individually too weak to provoke the motor units into discharging activity, can by summation become effective for that activation.

The reflex excitation provoking contraction of the muscle is shown to be accompanied regularly in the spinal centre by concomitant subliminal excitation in other spinal motor cells over and above those excited to actual discharge. The time relation of central subliminal excited states obtaining in certain typical reflexes has been determined (J. C. Eccles). By the summation of subliminal excited states this fringe of subliminal effect is a functional means of liaison enabling co-operation between different adjuvant parts of the nervous system. Although the neuron upon which convergent arcs interact is subject to their combined influence, and is to that extent an instrument passive in their hands, it is an instrument clearly with ways of its own. Thus, to receipt of a single stimulus it may react by a response consisting of a whole tetanic series of impulses.

Another and third set of cases arising from interaction at the convergence point is where the upshot is inhibition. The clash is between 'central' excitation and a central process which arrests or precludes it, but about which all that is known is that it antagonises excitation. Evidence was adduced of

[1] Summary of the David Ferrier Lecture delivered before the Royal Society on Thursday, June 20, by Sir Charles Sherrington, O.M., F.R.S.

quantitative interplay of the opposed influences upon the individual neuron Conditions favouring inhibition were discussed

Though trains of impulses are the sole reactions which enter and leave the central nervous system, it is clear that nervous impulses are not the sole reactions functioning within that system States of excitement which can sum together, and states of inhibition which can sum together, and states which represent the algebraical summation of these two, are among the central reactions The specific cell units, the neurons, far from behaving merely as passive recipients and transmitters of impulses, modify as well as transmit what they receive

Joint Russian-German Expedition to the Pamir

A JOINT expedition to the Pamir was organised last year by the Russian Academy of Sciences and the Notgemeinschaft der Deutschen Wissenschaft, consisting of eleven German members and about thirty Russians representing various branches of science, under the leadership of N P Gorbunov The expedition started in June from Osh (in Turkestan) and went through Gultcha into the Alai valley, then across the Transalai ridge to the alpine lake Kara kul, from there various sections of the expedition radiated in different directions, and the field work went on until November Scientific results of the expedition will take some time to work out fully, but a preliminary account, as published in the *Information Bulletin* of the Russian Academy (No 3 4, for 1929), already gives some idea as to their value

The geographical section of the expedition collected exhaustive information on the areas traversed Of particular interest was a study of Fedtchenko's glacier, which has been found to extend for more than 75 km, that is, it ranks amongst the largest glaciers in the world The topographical section accomplished the enormous task of surveying the wide expanse of Pamir, most of the work had to be done at the altitudes exceeding 4000 metres, which made it exceedingly difficult Nine astronomical and twelve triangulation points were determined, and altitudes of twenty two mountains estimated The meteorological and geophysical section made regular meteorological, aerological, actinometric and hydrological observations, 47 geomagnetic points and 150 gypsometric points were determined The geological section studied the history of the glaciation of the Pamir and prepared a general geological map of the area, the mineralogical collections are very rich and contain proofs of a number of useful minerals

The zoologists of the expedition collected more than 13,000 animals, mainly insects, it was interesting to find some southern forms at very great altitudes, thus at 3700 m, scorpions, Mutillid wasps, *Ammophila, Bombus melamorus*, etc, were found Experiments in hybridisation of *Ovis poli* with the domestic sheep were made and the progeny will be studied in detail Apart from the specimens collected, a considerable number of living local animals was sent from the Pamir to the Moscow Zoological Garden The linguistic section collected materials for a dictionary of the Tadzhik language, made phonograph records of native speech, and studied native customs and folk lore The radio section of the expedition had three transmitting stations at its disposal, apart from keeping in touch with central Russian stations, it made a series of experiments relating to the transmission under the peculiar local conditions A kinematographic section made about 9000 metres of films of all places and phases of the expedition The Alpine section made about thirty ascents to the highest peaks of the Pamir, the greatest height reached being 7120 m (Lenin's peak)

Scientific results of the expedition will be published in parts, as the working out of materials proceeds, it is suggested that the whole series, which will be published partly in Russian, partly in German, will be completed in 1930, apart from detailed monographs on different problems which will be published separately

University and Educational Intelligence

CAMBRIDGE —The Harkness Scholarship in geology has been awarded to L Bairstow, King's College The Anthony Wilkin Studentship in archeology and anthropology has been awarded to J B Charlesworth, of Christ's College

The following reappointments have been made F W Dootson, University lecturer in chemistry, P M S Blackett, University demonstrator in physics R G W Norrish, University demonstrator in chemistry, E M Taylor, University lecturer in agricultural chemistry, E H B Boulton, University lecturer in forestry, H E Woodman University demonstrator in agricultural chemistry, C E Tilley University lecturer in petrology W A Fell, University demonstrator in anatomy, F W Dootson, University demonstrator in chemistry

Dr W M Smart, of Trinity College chief assistant at the Observatory, has been reappointed to the John Couch Adams astronomership

Frank Smart Prizes have been awarded to H R Barnell, of Downing College, in botany, and to R J Pumphrey, of Trinity Hall, in zoology

The syndicate to consider the organisation and finance of the Botanic Garden has reported to the University The most important of its recommendations are the following

(1) The Botanic Garden should become an integral part of the Department of Botany and the responsible head of the Garden should be the professor of botany

(2) The duties of the Director of the Garden should be general responsibility for the management of the Garden and particular care for its development as an aid to the study of botany

(3) The stipend attaching to the office of Director should be variable according to the nature of the other offices held simultaneously by the Director

(4) A new University lectureship should be created for the teaching of systematic botany

(5) Consideration should be given to the fact that a part of the land adjoining the Garden could be sold under suitable restrictive conditions without detriment to the present or future needs of the Garden

(6) The town of Cambridge should be invited to contribute to the cost of the Garden, so long as it is made accessible to the general public

GLASGOW —Prof J W Gregory, having attained the age of sixty five years during the past session, has resigned the chair of geology in the University which he has held since 1904 Prof Gregory is not subject to the age limit regulation, but he has decided to retire to make way for a younger man and to devote his time to the completion of work in which he has been engaged

Among others, the honorary degree of LL D was conferred on June 19 on Prof H S Carslaw, professor of pure and applied mathematics, University of Sydney, Madame Marie Curie, of Paris, The Earl of Elgin, chairman of the Carnegie United Kingdom Trust, C O Hawthorne, chairman of the Repre

sentative Body of the British Medical Association, and Lord Lugard, ex Governor of Nigeria

LIVERPOOL —The Council of the University, at its meeting on June 18, elected Dr D B Blacklock, professor of tropical diseases of Africa, to the Walter Myers chair of parasitology Prof Blacklock is a graduate of the University of Edinburgh From 1911 until 1914 he was in turn assistant director and director of the Runcorn Research Laboratory In 1914 he became a member of the commission appointed to investigate the problems of sleeping sickness in West Africa, and was elected to a lectureship in parasitology in the University of Liverpool During the War period he was in charge of a pathological laboratory and conducted investigations on malaria on behalf of the War Office Prof Blacklock has been secretary and a vice president of the Tropical Section of the British Medical Association and has played an active part in the promotion of tropical medical research

At the same meeting the Council appointed Mr E C Titchmarch to the chair of pure mathematics in the University, and Dr J H Orton to the Derby chair of zoology Mr Titchmarch, a scholar of Balliol, was appointed in 1923 to a lectureship in mathematics at University College, London, and to a fellowship of Magdalen College, Oxford Since 1925 he has been reader in mathematical analysis in the University of London Dr Orton is a graduate of the Royal College of Science, London In 1914 he was appointed assistant naturalist at the Marine Biological Laboratory, Plymouth, and after War service returned to the laboratory, in which he was promoted in 1924 to the post of chief naturalist He has conducted extensive research on problems of marine biology, paying particular attention to the life history of the oyster

MANCHESTER —A limited number of research scholarships in technology, each of the value of not more than £100, are to be awarded in July by the Manchester Municipal College of Technology Application forms, returnable by, at latest, July 6, can be obtained from the Registrar of the College

KING'S COLLEGE, London, celebrated during the past week the hundredth anniversary of its foundation The celebrations, inaugurated on Tuesday by their Royal Highnesses the Duke and Duchess of York, included the dedication of the chapel and opening of the library and new wing of the Vincent Square hostel by the Archbishop of Canterbury, who is the official Visitor Beginning in 1829 with work of university standard in arts, science, and medicine, and a 'junior department' which became the present King's College School at Wimbledon, the growth of the College has been marked by the establishment of an engineering department in 1838, a hospital (now on Denmark Hill) in 1839, a theological department for the training of clergy in 1847, evening classes in 1856, a department for women (in Kensington) in 1885, and a teacher training department in 1890 The post War years have seen a remarkable further enlargement of its activities and increase in the number of its students, with the result that additional accommodation is urgently required, especially in the departments of chemistry and anatomy The building scheme designed to meet this need at a cost of £125,000 will, if carried out, improve the architectural amenity of the Thames frontage in the neighbourhood of Waterloo Bridge For this, and for the endowment of professorial chairs and scholarships the College is asking the public to subscribe to its centenary appeal fund

Calendar of Patent Records

June 29, 1722 —A patent was granted on June 29, 1722, to Martin Triewald, the Swedish engineer, for his invention of a "certain engine or machine for drawing water out of mines and collyeries by the power of the atmosphere" Triewald, who was in England when the first Newcomen engines were [illegible] set up and himself helped in the erection of one, built the first engine in Sweden, that for the Dannemora mines, and is the author of the earliest monograph on the steam engine, which was published at Stockholm in 1734 Triewald claims to have made improvements on the engine, but what these were and what was the construction for which his patent was granted he does not say

July 1, 1769 —The stamped brass trade dates from the patent of John Pickering, whose specification was enrolled on July 1, 1769 The invention consisted of a "new method of performing that kind of work commonly called chasing in gold, silver, brass, tin, or other metal, by a machine consisting of an oblong frame with two rods, in which a moving forcer is worked upon a striking block with a die fixed thereon formed for each respective purpose, whereby the work is executed in a much more expeditious manner and far superior to anything of the kind (not being actual chasing) ever yet performed by any other means"

July 1, 1877 —There was no common patent law for Germany before 1877, but for many years patents had been granted by the constituent States under their respective laws and regulations The first patent law of the German Empire, superseding the various State laws, came into force on July 1, 1877, and the first patent under it dates from the following day

July 3, 1769 —The practical application of the principle of roller drawing in cotton spinning is due to Sir Richard Arkwright, whose patent for the invention was sealed on July 3, 1769 Arkwright was partnered and greatly helped in the establishment of the industry which was started at Cromford Mill, Derbyshire, by Jedediah Strutt, the inventor of the rib stitch hosiery frame

July 3, 1861 —The manufacture of mechanical wood pulp for papermaking was the invention of F G Keller in 1845, but its commercial introduction and development are mainly due to Heinrich Voelter, papermaker, of Heidenheim, who was granted a Prussian patent for five years for his improved process on July 3, 1861

July 4, 1767 —On July 4, 1767, there was granted a patent to John Winn, a shipwright of Shadwell, for a method of saving life "in case of a ship being in distress on a lee shore where a boat cannot live" Ropes were sent ashore by means of a buoy, and the passengers and crew were then transported in a basket slung on one of the ropes and hauled to the shore

July 6, 1897 —The patent of Walther Nernst, of the University of Göttingen, for the electric lamp which is known by his name, was granted in Germany on July 6, 1897 At the time of its introduction, practically no improvement had been made in the earlier carbon filament lamp, other than in the details of the manufacturing processes, and Nernst utilised for his lighting element one of the refractory rare-earths, which allowed a current to pass after a preliminary heating, and withstood a greatly increased temperature He succeeded in reducing the consumption from the 4 watts per candle power of the carbon filament to 1 5 watts The lamp has now been very largely displaced by the metal filament lamp

Societies and Academies

LONDON

Royal Society June 13 —W S Stiles The scatter … theory of the effect of glare on the brightness … threshold The theory that the observed increase in the threshold due to the presence of a glare source in the field is caused by light scattered in the eye media is formulated mathematically Deductions from it are not in accord with observation The general conclusion is that the scattering effect can play only a subsidiary part in increasing the threshold Grace Briscoe and Winifred Leyshon Reciprocal contraction of antagonistic muscles in peripheral preparations using flashing neon lamp circuit for excitation of nerve Controlled and co ordinated rhythmic movements of a limb closely resembling natural movements are produced by suitable artificial stimulation of out efferent nerves If during this controlled rhythmic movement the mechanism producing phasic variation is stopped at any point the limb remains held in posture The method of stimulation is thus adequate for both movement and posture An analysis of the forces controlling movement shows that the control of relaxation is as important for smooth co ordination as the control of contraction —T Moran Critical temperature of freezing living muscle Up to 40 per cent of the water in amphibian muscle can be removed by freezing or drying and its original state completely recovered by restoring water On removal of 78 per cent the muscle immediately dies The critical water removal of 78 per cent corresponds to the freezing of the muscle to equilibrium at about 2° C Muscles frozen to equilibrium below 2° C undergo marked changes on thawing —E C Smith The formation of lactic acid in muscles in the frozen state Freezing (that is drying) upsets the balance making production exceed removal This upset is due to or accompanied by injury to the mechanism Below 1 6° C the mechanism of removal is destroyed that of production persisting Is the mechanism of removal the living part?—F M L Sheffield Chromosome linkage in *Oenothera* with special reference to some F_1 hybrids Most results can be brought into line with Cleland s hypothesis—absence of pairing due to lack of harmony between homologues Chromosome linkage may be inherited as a genetic character —A C Downing and A V Hill A new thermopile for the measurement of nerve heat production —A V Hill The heat production and recovery of crustacean nerve The heat production of crab s nerve in response to maximal excitation is at least $2\ 5 \times 10^{-5}$ calorie per gram of moist nerve per second of stimulus This is 33 times as great as in frog s nerve The crab s nerve is highly fatiguable The initial process, completed during stimulation, yields only about 2½ per cent of the total heat the recovery process lasting for 25 minutes at 16° C supplies the rest In respect of fatiguability and of oxygen requirement a crab s nerve probably presents a closer analogy to certain characteristics of the central nervous system than does a frog s sciatic

PARIS

Academy of Sciences May 22 —The president announced the death of M Depéret, non resident member, and of M Cornet foreign *correspondant* for the Section of Mineralogy —Léon Guillet, Jean Galibourg, and Michel Samsoen Extension tests at high temperatures Data are given for the elastic limits at 450° C for various alloy steels, including nickel, nickel-chromium, and nickel chromium-molybdenum steels No general conclusions can be drawn from the results but the previous heat treatment certainly has a considerable influence on the elastic characteristics at 450° C —Eduard Čech Some remarks relative to the differential projective geometry of surfaces —C Pawlowski Remarks on the disintegration of aluminium Discussion of the results obtained by the author and by Rutherford and Chadwick on the H rays of aluminium —Y Rocard The fall of a heavy gas in a light gas The stability of ozone in the upper atmosphere From considerations based on the kinetic theory of gases it is concluded that the velocity of ozone in nitrogen would be 22 metres per day and of ozone in hydrogen 17 metres per day In either case the atmospheric ozone is practically stable —L Genevois The variations of the respiratory intensity and of the intensity of fermentation in the tissues of the pea —Bounhiol Respiration in media containing an excessive percentage of oxygen The fact has been established by previous workers that animals breathing an atmosphere containing an excess of oxygen rapidly die Under these conditions there is a rapid increase in the proportion of urea in the blood and the accumulation of oxidation products in the blood prevents the fixation of fresh oxygen —L Lutz The soluble ferments secreted by the hymenomycete fungi The alkaloids and the anti oxygen function

LENINGRAD

Academy of Sciences (*Comptes rendus* No 2) —P P Lazarev Modern treatment of malignant tumours from the point of view of the ionic theory of excitation The success of treatment of malignant tumours by calcium salts is explained by the suggestion that calcium ions inhibit the development of tumour cells while those of potassium and sodium favour it V Vernadskij The concentration of radium by living organisms Radium from water solutions is absorbed by aquatic organisms both vegetable and animal and is concentrated there from solutions in soil it is absorbed by terrestrial plants and from drinking water by terrestrial animals In some cases the concentration of radium in an organism was found to exceed that in water 56 5 times —V Vernadskij Rare earths elements in massive rocks Minerals rich in rare earths are found mainly in pegmatite seams but their occurrence in the rocks proper is not clear probably because of insufficiently exact methods of examination —V Vernadskij The geochemical constants of some cultivated plants Geochemical energy of the best selected varieties is less than the energy of the varieties usually cultivated —A Vinogradov Chemical composition of plankton from the Ekaterininsky pond at Dietskoe Selo, near Leningrad —D Grave Magnetic anomalies A reply to the critical note by Kravetz (*Comptes rendus*, p 470 1928) —N Olenev Systematics and geographical distribution of Ixodidæ (3) The genus *Rhipicephalus* is represented in Russia by three species *R sanguineus* Latr *R bursa* Can et Fanz, and *R schulzei*, sp n The genus *Boophilus* is represented only by *B calcaratus* Birula The geographical distribution and hosts of each species are given —G Veretschagin and I Sidorytchev Winter chemical regime of the rivers Selenga and Uda The oxygen content of the water decreases sharply from the end of November and reaches its minimum early in February parallel to that process the carbon dioxide content increases This must be of great importance to fish life

(*Comptes rendus*, No 3) —V A Silberminz The deposits of cerite, bastnæsite, and a new mineral, lessingite, in the Kyshtym district Urals The deposits are described, and descriptions and chemical

analyses of the three minerals are given —**A Mordvilko** The anolocyclic plant lice of *Pistacia* and the distribution of pistachios during the Tertiary period The genus *Pistacia* was very widely distributed in the Tertiary, extending northwards as far as Greenland, where the plant lice *Triphidaphis phaseoli*, representing a migrant form from pistachios, survive until the present time While *Pistacia* disappeared in such high latitudes under the influence of cold climate, it is impossible to account in the same way for the disappearance of *Pistacia* in some Mediterranean countries where in places only root forms of pistachio aphids are to be found at present — **A Frank-Kamenetskii** The fat of *Phoca sibirica* Gmel Physical and chemical properties of the fat are described fully —**D D Ivanenko** A geometrical generalisation which may be useful in the quantum mechanics

(*Comptes rendus*, No 4)—**P Lazarev** The causes of plasticity of substances The greater plasticity of loam as compared with sand is due to the ability of particles of loam to bind water on their surfaces Capillarity must also play some part in the plasticity - **L A Kulik** The Mamra meteorite A description of a meteorite which fell at Mamra in Kazakstan (Kirghiz Steppes) at night on May 5, 1927 The meteorite belongs to the stony meteorites and, probably, to sulphurous chondrites —**V I Romanovskii** The law of probability of frequencies subject to linear conditions and Pearson's criterium χ^2 —**A A Birula** The pelvic bone of *Rhytina stelleri* Oser Amongst the semi fossil remains of *Rhytina stelleri* found at the Komandor islands, pelvic bones are rare , a detailed description of one such bone is given and illustrated —**A A Birula** A preliminary communication on the mammals of the kitchen midden of a Stone Age habitation on the Verkholensk mountain near Irkutsk Remains of twelve species of mammals have been identified —**N Smirnov** Diagnoses of some geographical varieties of *Phoca hispida* Schreb Two new subspecies and one new form are described — **E G Shramkov** The stability of the permanent magnetism of some rocks —**B V Numerov** The relation between the local anomalies of gravity and the derivatives of the potential

PRAGUE

Czech (Bohemian) Academy of Arts and Sciences (second class, Natural Sciences and Medicine), Mar 8 —**J Petrbok** Stratigraphy of the Pleistocene and Holocene in the plain of Arsuf in Palestine —**Fr Cechura** Geomagnetic examination of the contact of Algonkian and granite near Příbram —**J Sekanina** The symmetry of tourmaline —**J Hýbl** The dependence of saturated vapour pressure on temperature The author tested various formulæ with the vapour pressure data of liquid carbon dioxide, sulphur dioxide, ammonia, water, and hydrocarbons , the best record is given by a shortened formula of Kamerlingh Onnes : $\log p = a - \frac{b}{T} - cT + dT^2$ —**Jar Hahn** *Monocystis Mrázeki* —**J Křepelka** and **F Toul** The dissolution of silver in water Silver passes as Ag^+ into water containing atmospheric gases, being oxidised The amount, determined by nephelometry, potentiometry, and conductance, varies between 0 01 mgm and 0 037 mgm Ag^+ per litre —**K Petr** The composition of *n* ary quadratic forms —**E Votoček** and **F Rác** The identity of E Fischer's quinovose with *d* glucomethylose (isorhodeose) Reduction of quinodose with sodium amalgam and identification of the methylpentite obtained with isorhodeite leads the authors to the same conclusion as Freudenberg and Raschig on the isolation of crystalline quinovose

ROME

Royal National Academy of the Lincei, Mar 17 — **P Vinassa de Regny** The law of simple parametral relations and the distances of the components of the solar system It has been recently shown that Haüy's law concerning simple and rational parametral relations holds not only for crystal lattices, but also for the distances of the electrons from the atomic nucleus A similar relationship is now shown to exist in the cases of the sun's planets and of the satellites of Mars, Jupiter, Saturn, and Uranus — **E Soler** The second gravimetric campaign on the Carso Measurements made in 1926 at S Canziano give for the gravitational constant the observed values, 980 568 cm outside and 980 604 inside the cave, these becoming 980 698 and 980 696 respectively when corrected for the reduction in free air, and 980 661 and 980 684 when Bouguer's and topographical corrections are applied The discrepancy between these values is considerably greater than the mean errors and is to be discussed later The normal gravity value, derived from Helmert's formula (1901), is 980 676 cm —**U Pierantoni** The symbiotic organ of *Silvanus surinamensis* (L) —**G Bemporad** Photographic position of planet (1036) —**T Boggio** Hypersurfaces of spaces of constant curvature — **V Glivenko** Certain general forms of the law of large numbers — **A Kolmogoroff** The law of large numbers —**Maria Pastori** Total and partial commutation relative to derived tensors – **G Scorza-Dragoni** The continuous dependence of the integrals of the equation $y' = f(x, y)$ on the initial values —**Pia Nalli** The principal value of an integral —**S Finikoff** The congruences of Demoulin —**M Manarini** The motion of two variable masses which attract one another according to Newton's law Vranceanu's equations (1928) have indicated the difficulty of this problem, but the introduction of a simple and plausible hypothesis regarding the variation of the masses furnishes a means of simplifying the investigation and of obtaining results comparable with those of Armellini (1915) and of Pizzetti (1915) —**A Clementi** investigations on arginase (7) Ureotelic character of the nitrogen metabolism of Chelonia The urine of *Testudo Græca* and *Emys Europæa*, like that of *Bufo*, contains uric acid in very small proportions only, which are usually too minute to be determined In the summer season the content of urea in the urine of these two organisms corresponds approximately with that in the urine of *Bufo* at the same period, namely, about 0 5 part per 1000 Oral administration of ammonia to *Testudo* and *Emys* causes a very marked increase in the urea content *proprio* and per 1000 of the urine, this being contrary to what is observed with uricotelic animals (birds) Hence, the nitrogen metabolism of the Chelonia is not, as with other reptiles and with birds, uricotelic, but ureotelic —**V Rivera** Experimental cicatrisation of the stem of *Ricinus communis*, determined by *Pseudomonas fluorescens* (Flugge) Migula Cuts made aseptically in the stem of *Ricinus*, and afterwards inoculated with a pure culture of *Pseudomonas fluorescens*, gradually seal up as a result of pronounced cellular proliferation at the sides of the cut, whereas control cuts, uninoculated, undergo no such sealing It may, therefore, be assumed that this organism, which is of universal occurrence, is the cause of the cicatrisation often observed after a root or a stem has been wounded

WASHINGTON, D C

National Academy of Sciences (*Proc* , Vol 15, No 2, Feb. 15) —**Arthur M Banta** and **L A Brown** Control of sex in Cladocera (3) Localisation of the critical period for control of sex Females of *Moina macrocopa*

produce parthenogenetic eggs or, under adverse conditions, sexual eggs Crowding of the females leads to production of eggs giving males, the critical time for crowding is about four hours (at 20° C) before oviposition, which is more than three hours before spindle formation in the nuclei —**Chas W Metz** and **Silka S Ullian** Genetic identification of the sex chromosomes in *Sciara* (Diptera) The males alone of these dipterans have two peculiar 'sex limited' chromosomes, but these chromosomes are transmitted by all sperms Sex chromosomes distinct from these have been detected by tracing the inheritance of a sex linked character, swollen wing veins —**Gregory Pincus** A spontaneous mutation in the house mouse —**G A Miller** Possible n automorphisms of non Abelian groups —**W L Ayres** (1) On continuous curves having certain properties —(2) On simple closed curves and open curves —**I A Barnett** On a relation between conformal and projective groups in function space —**Francis D Murnaghan** On elements of content in metrical geometry —**G C Evans** and **E R C Miles** Potentials of general masses in single and double layers The relative boundary value problems —**H S Vandiver** Summary of results and proofs on Fermat's last theorem (4) —**Francis B Sumner** The analysis of a concrete case of intergradation between two subspecies A mouse, *Peromyscus polionotus*, common in Florida and Alabama, has two races distinct in several characters, one existing on the coastal region and the other inland The races are interfertile, but trapping them at a line of stations running inland shows an abrupt transition from one to the other The coastal form seems to have arisen from the inland or a similar ancestral race, in adaptation to life on a background of pale sand —**Edwin B Wilson** and **Margaret M Hilferty** Note on C S Pierce's experimental discussion of the law of errors The mean and standard deviation for many observations of an identical experiment repeated on 24 days vary much more than is predicted by the law of errors —**Edwin H Hall** Photoelectric emission and thermionic emission once more A theoretical criticism of experiments suggesting that photoelectric and thermionic work functions are equal —**Gilbert N Lewis** and **Joseph E Mayer** The quantum laws and the uncertainty principle of Heisenberg In earlier papers, the second and third laws of thermodynamics were deduced from a single statistical principle implying that the properties of a system can be described by assuming a finite number Ω of possible states Assuming that Ω is a minimum *sufficient* to account for the whole *behaviour* of a system, the fundamental laws of the quantum theory are developed —**E L Nichols** and **H L Howes** The transformation spectrum of the ruby An incandescent ruby gives a continuous spectrum on which is superimposed a system of narrow emission bands The latter appear in the temperature range corresponding to changes in the absorption of light by the ruby and occur in sets, including also the absorption and fluorescence bands of the ruby, with a constant frequency interval —**Leonard B Loeb** and **Karl Dyk** The effects of a homologous series of amines on the mobilities of ions in hydrogen gas With *N* propyl amine, there is a large initial drop in mobility of both positive and negative ions With methylamine the negative ion mobility is decreased but the positive ion mobility is unaffected Although the results are consistent with the formation of addition products with only one or two molecules, this explanation is not accepted —**Marius R Campbell** Late geologic deformation of the Appalachian Piedmont as determined by river gravels The rocks of this region are old, but minor flexures of more recent date have been discovered by tracing high level gravels in the area. Sections and a map are given

Official Publications Received.

BRITISH

Proceedings of the Royal Society of Edinburgh Session 1928 1929 Vol 49 Part 2 No 15 The Stability of Suspensions III The Velocities of Sedimentation and of Cataphoresis of Suspensions in a Viscous Fluid By William Ogilvy Kermack Anderson Gray M Kendrick and Eric Ponder Pp 170 187 2s 6d Vol 49 Part 3 No 16 The Lyotrope Series and the Antagonistic Action of Ions By Dr W W Taylor Pp 198 209 1s Vol 49 Part 3 No 17 On the Asymptotic Expansion of the Characteristic Numbers of the Mathieu Equation By Sydney Goldstein Pp 210 223 1s Vol 49 Part 3 No 18 Quanta in Biology By Hans Przibram Pp 224 231 9d Vol 49 Part 3 No 19 Colour Sensitivity By G N Hunter Pp 232 244 1s Vol 49 Part 3 No 20 Bands in Hydrogen related to the Fulcher System By Dr Ian Sandeman Pp 245 255 1s (Edinburgh Robert Grant and Son London Williams and Norgate Ltd)

Harper Adams Agricultural College Newport Salop Advisory Report No 4 Report of the Advisory Department 1928 1929 Pp ii+24 (Newport Salop)

Transactions of the Yorkshire Numismatic Society Vol 3 Part 2 Edited by T Sheppard Pp 77 80 (Hull) 5s

The Ross Institute and Hospital for Tropical Diseases (Incorporated) Putney Heath, London S W 15 Annual Report and Accounts for 1928 Pp 33 (London)

The Proceedings of the Physical Society Vol 41 Part 4 No 229 June 15 Pp iv+231 430 (London) 7s n t

The Journal of the Institution of Electrical Engineers Edited by P F Rowell Vol 67 No 390 June Pp 681 81 +xxxviii (London E and F N Spon Ltd) 10s 6d

Memoirs of the Cotton Research Station Trinidad Series A Genetics No 1 Studies on the Inheritance of (a) Petal Spot (b) Pollen Colour and (c) Corolla Colour in the Cotton Plant By S C Harland Pp 53+1 plates (London Empire Cotton Growing Corporation) 2 6d

The Himalayan Journal Records of the Himalayan Club Edited by Kenneth Mason Vol 1 No 1 Pp 130 (Calcutta Thacker Spink and Co) rupees 8s

Joint Board of Research for Mental Diseases City and University of Birmingham Annual Report of the Laboratory for the Year ending March 14th 1929 Pp 17 (Birmingham)

Canada Department of Mines Mines Branch Industrial Fuel and Power Statistics for Ontario Calendar Year 1928 By E S Malloch and C E Baltzer (No 698) Pp iv+23+12 plates (Ottawa F A Acland)

Department of Agriculture Ceylon Bulletin No 84 Fodder Grass Trials on the Experiment Station Peradeniya By T H Holland Pp 12+6 plates 40 cents Bulletin No 85 The Termite proof Construction of Buildings in Ceylon By F P Jepson Pp iv+36+26 plates 40 cents (Peradeniya.)

The Economic Proceedings of the Royal Dublin Society Vol 11 No. 5 The Production of Essential Oils from Irish grown Plants Part Note on Oil of Dill By J Reilly P J Drumm and C Boyle Pp 41 418 (Dublin Hodges Figgis and Co London Williams and Norgate Ltd) 6d

Survey of India General Report from 1st October 192 to 30th September 1928 Pp v+86+4 plates (Calcutta) 1 rupee 1s 3d

Records of the Geological Survey of India Vol 61 Part 4 March Pp 327 367+xxx+vii+plates 26 29 2 1 rupees 5s Vol 62 Part 1 April Pp 185 2 10 rupees 5s (Calcutta Government of India Central Publication Branch)

Air Ministry Aeronautical Research Committee Reports and Memoranda No 1179 (Ae 343) The Airflow around a Circular Cylinder in the Region where the Boundary Layer separates from the Surface By A Fage (T 2644) Pp 18 9d net No 1194 (Ae 356) An Investigation of Fluid Flow in Two Dimensions By Dr A Thom (T 2680) Pp 18+10 plates 1s net. No 1206 (Ae 367) Wind Tunnel Experiments with Infinite Cascades of Aerofoils By Dr R G Harris and R A Fairthorne (T 2685) Pp 18+11 plates 1s net. No 1211 (Ae 370) On the Effect of Air Compression on Drag and Pressure Distribution in Cylinders of Infinite Aspect Ratio By T E Stanton (T 2689) Pp 5+2 plates 6d. net No 1218 (Ae 377) The Hydrodynamic Factors on a Cylinder moving in Two Dimensions By Prof H Lamb (T 2744) Pp 5 4d. net (London H M Stationery Office)

University of Bristol The Annual Report of the Agricultural and Horticultural Research Station (The National Fruit and Cider Institute), Long Ashton, Bristol 1928 Pp 200+9 plates. (Bristol)

The Cawthron Institute Nelson N Z Cawthron Lecture The Work for Agriculture of Two Great Englishmen By Sir John Russell Pp 12+6 plates (Cawthron N Z.)

Department of Scientific and Industrial Research Dominion of New Zealand Observations of Upper Air-Currents at Apia Western Samoa. (Second Series) By Andrew Thomson Pp 79 (Wellington N Z W A. G Skinner)

The University of Leeds Department of Coal Gas and Fuel Industries (with Metallurgy). Report of the Livesey Professor for the Sessions 1926-27 and 1927 28 Pp. 15 (Leeds)

Proceedings of the Society for Psychical Research Part 111 Vol 38, June Pp. 411 516 (London Francis Edwards, Ltd) 4s

Empire Cotton Growing Corporation Report of the Eighth General Meeting Pp 16. (London)

The Newcomen Society for the Study of the History of Engineering and Technology Transactions, Vol 7 1926-1927 Pp. xi+159+21 plates. (London) 20s

FOREIGN

Svenska Linné Sällskapets Årsskrift. Årgång 12 1929 Pp. v+194 (Uppsala Almquist and Wiksells Boktryckeri A B)

Proceedings of the Imperial Academy Vol 5 No. 4 April Pp. vii+161 181 (Tokyo)

Přírodovědecké práce J E Purkyně v zrcadle kritiky jiných badatelů Ce qui a été écrit sur les travaux scientifiques de Jan Evangelista Purkyně (Purkinje) par les biologistes. Napsal O V Hykeš Pp 51 (Praha Knihtiskárna Jednoty československých matematiků a fysiků)

Spisy vydávaní Přirodovědeckou Fakultou Masarykovy University Čis 103 Příspěvek ke studiu komplexních solí dimethylglyoximu (Contribution à l'étude de combinaisons complexes de la dimethylglyoxine). Napsali J V Dubský a Fr Brychta Pp. 28 Čis. 104 Sur une classe de surfaces Par Jos. Kaucký Pp 21 Čis 105 Iter Turcico-Persicum Pars 4 Plantarum collectarum enumeratio (Plumbagineae—Cyperaceae) Scripsit Dr Fr Nábělek Pp 48+4 tab Čis. 106 Sur une classe de surfaces minima plongées dans un espace à cinq dimensions à courbure constante Par Otakar Borůvka. Pp. 28 Čis 107 Sur les surfaces du troisième degré qui ont, aux points d une courbe plane, un contact d ordre deux avec une surface générale Par Ladislav Seifert. Pp. 17 Čis. 108 Nový typ thermostatu (A new Type of Thermostat). Napsal Václav Cupr Pp. 8 (Brno A Píša.)

Proceedings of the California Academy of Sciences, Fourth Series Vol 17, Nos 11 and 12 Report of the President of the Academy for the Year 1928, by C E Grunsky Report of the Director of the Museum for the Year 1928, by Barton Warren Evermann Pp. 297 360 (San Francisco.)

Bergens Museums Årbok, 1929 Hefte 1 Naturvidenskapelig rekke Nr 1 Draktskiftet hos lirypen (*Lagopus lagopus* Lin.) i Norge av Sigurd Johnsen, Nr 2 Rovdyr og rovfuglstatistikken i Norge av Sigurd Johnsen Pp. 84+140+17 plancher (Bergen A.-S John Griegs Boktrykkeri)

Proceedings of the United States National Museum Vol 75 Art. 15 A new Crab from the Eocene of Florida. By Mary J Rathbun (No 2786.) Pp 4+3 plates (Washington D C Government Printing Office.)

Gorgas Memorial Laboratory Hearings before the Committee on Foreign Affairs House of Representatives, Seventieth Congress, First Session on H R 8128 *To authorize a Permanent Annual Appropriation for the Maintenance and Operation of the Gorgas Memorial Laboratory* January 20 1928 Statements of Hon Maurice H Thatcher, Dr Franklin Martin Edgar Wallace, Dr Bowman C Crowell, Dr George W Crile Henry S Wellcome Surg Gen. Merritte W Ireland Surg Gen Hugh S Cumming Dr Arthur T McCormack Dr Herman N Bundesen Pp iv+90 (Washington, D C Government Printing Office.)

Memoirs of the College of Science, Kyoto Imperial University Series B Vol 4 No 3 Articles 7 17 Pp 165 369+plates 26-30 (Kyoto and Tokyo Maruzen Co Ltd)

Carnegie Institution of Washington Year Book No 27, July 1 1927, to June 30, 1928 with Administrative Reports through December 14 1928 Pp xix+438+2 plates. (Washington, D C Carnegie Institution)

Studies in Comparative Seismology Earthquake Conditions in Chile By Bailey Willis With Contributions by J B. Macelwane, Perry Byerly, Johannes Felsch and H. S. Washington (Publication No 382) Pp xi+178+75 plates. (Washington D C Carnegie Institution) 5 50 dollars

Miocene Mollusks from Bowden Jamaica Part 2 Gastropods and Discussion of Results. By Wendell P Woodring (Contributions to the Geology and Palaeontology of the West Indies) (Publication No 385) Pp vii+564 (40 plates) (Washington, D C Carnegie Institution.) 7 dollars.

The Genus *Haplopappus* a Phylogenetic Study in the Compositae By Harvey M Hall (Publication No 389) Pp viii+391 (16 plates) (Washington D C Carnegie Institution) 5 dollars

The Hydrostatic Pneumatic System of certain Trees Movements of Liquids and Gases By D T MacDougal J B Overton and Gilbert M Smith (Publication No 397) Pp. 99 (Washington D C Carnegie Institution) 1 25 dollars

Contributions to Palaeontology from Carnegie Institution of Washington Papers concerning the Palaeontology of the Cretaceous and Later Tertiary of Oregon of the Pliocene of Northwestern Nevada and of the Late Miocene and Pleistocene of California. By Charles W Gilmore John H Maxson, John C Merriam and Chester Stock (Publication No 393) Pp. v+58+18 plates. (Washington, D C Carnegie Institution) 1 50 dollars.

Papers from the Tortugas Laboratory of Carnegie Institution of Washington. Vol. 26 An Investigation on Organization in a Sea Urchin Egg, by David H. Tennent, C V Taylor and D M Whitaker Activation of the Eggs of *Echinometra mathaei* by Sperms of the Crinoids *Comatula pectinata* and *Comatula purpurea*, by David H Tennent, Early Development and Larval Forms of three Echinoids of the Torres Strait Region, by David H. Tennent, On the Postlarval Development of the Coral *Maeandra areolata* (L.), by H Boschma On the Morphology, Coloration and Behavior of seventy Teleostean Fishes of Tortugas, Florida, by E W Gudger Observations on certain Littoral and Terrestrial Animals at Tortugas, Florida, with Special Reference to Migrations from Marine to Terrestrial Habitats, by A. S Pearse Two new Mites from the Gills of Land Crabs, by A. S. Pearse, Further Studies on Marine Bacteria with Special Reference to the Drew Hypothesis on $CaCO_3$ Precipitation in the Sea, by C B Lipman The Chemical Composition of Sea-Water by C B Lipman. Pp. iii+257+4 plates. (Washington, D C Carnegie Institution) 2.50 dollars.

Japanese Journal of Astronomy and Geophysics Transactions and Abstracts. Vol 6, No 3 Pp. iii+143-178+39-64 (Tokyo National Research Council of Japan)

Scientific Papers of the Institute of Physical and Chemical Research. No. 189: A Study on the Helium Band Spectrum, 2 By Sunao Imanishi. Pp. 237 252+plates 23-25 (Tokyo Iwanami Shoten) 35 sen.

CATALOGUES.

The Far East its History, Literature and Arts Books and Views relating to Japan, China, Korea, Formosa, Siam, the Philippine Islands and the Far East Indian Archipelago (Catalogue 516.) Pp. 48. (London Francis Edwards, Ltd)

Early American Voyages and other Travels. (Catalogue No. 26) Pp. 46 (Newcastle-upon Tyne William H Robinson.)

Diary of Societies.

FRIDAY, JUNE 28.

PHYSICAL SOCIETY (at Imperial College of Science), at 4 45 —Dr Teresa J Dillon The Relation between Hydrogen Pressure and Filament Resistance in a Tube containing Glowing Tungsten.—Dr Frances Lowater The Band Systems of Titanium Oxide —F E Smith The Absolute Measurement of Sound Intensity —A Demonstration of an Apparatus for the Measurement of Electrical Resistance at High Temperatures will be given by Dr J L Haughton.

MONDAY, JULY 1

ROYAL SOCIETY OF EDINBURGH, at 4 30 —Gunning Victoria and Makdougall Brisbane Prizes to be presented —Prof R. A Sampson and Prof A E Conrady Description of Three Huygens Lenses in the Possession of the Royal Society of London —W J M'Callien The Metamorphic Rocks of Kintyre —Dr T M Finlay Old Red Sandstone of Shetland (North Western Area).

ROYAL INSTITUTION at 5 —General Meeting

TUESDAY, JULY 2

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (jointly with Institution of Engineers and Shipbuilders in Scotland) (at Newcastle upon Tyne), at 10 A M —Sir Westcott S. Abell The Story of Safety at Sea.—J Ireland The Applications of Monel Metal in Engineering and Shipbuilding

INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (at Birmingham), at 11 A M.

ROYAL SOCIETY OF MEDICINE, at 4 30 —Annual General Meeting

BRITISH WATERWORKS ASSOCIATION (at Portsmouth) (continued on July 3, 4, and 5).

WEDNESDAY, JULY 3.

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (jointly with Institution of Engineers and Shipbuilders in Scotland) (at Newcastle upon Tyne), at 10 A.M —J L Adam Some Notes on Damage to Ships —R P Sloan Developments in the Uses of Electricity

FRIDAY, JULY 5

INSTITUTION OF CIVIL ENGINEERS (Birmingham and District Association), at 8.30 A M —Visit to Liverpool to see the Work in connexion with the Mersey Tunnel

OVERHEAD LINES ASSOCIATION at 12 15 P M —Visit to the Mid-Cheshire Electricity Supply Company

GEOLOGISTS' ASSOCIATION (in Architectural Theatre University College, Gower Street), at 7 30.—Christopher T A Gaster Chalk Zones in the Neighbourhood of Shoreham, Brighton, and Newhaven, Sussex.—H G Smith Some Features of Lamprophyres, near Sedbergh, Yorkshire

SATURDAY, JULY 6

PHYSIOLOGICAL SOCIETY (at Oxford).

TUESDAY JULY 9

SOCIETY OF CHEMICAL INDUSTRY (at Manchester), at 10 15 A M —Annual General Meeting —Dr A. D Little Science and Labour

WEDNESDAY JULY 10

SOCIETY OF CHEMICAL INDUSTRY (at Manchester), at 10 A.M —Annual Meeting.—Prof T H Pear The Human Factor in Industry —Dr A. D Little Process Development.

INSTITUTION OF MINING ENGINEERS (at University College, Nottingham), at 11 A.M —General Meeting —Dr W Hancock A G R. Whitehouse, and Dr J S Haldane The Salts lost by Sweating owing to High Air-temperatures (Sixteenth Report to the Committee on The Control of Atmospheric Conditions in Hot and Deep Mines).—Dr J S. Haldane Work of the Committee of the Institution of Mining Engineers on The Control of Atmospheric Conditions in Hot and Deep Mines.—The following papers will be submitted for further discussion —W S. Cooke and I C F Statham The Flow of Air at Bends and in Straight Airways (Sixth Report of the Midland Institute Committee on the Ventilation of Mines).—Dr T David Jones Spontaneous Combustion in North Staffordshire. Part II A Record of Analyses of Air-samples taken during the Combating of a Fire.—Dr T F Wall: Electro-magnetic Testing of Wire Ropes.—2.15 —The General Meeting will be resumed —3 30 —The General Meeting will be closed.

CONFERENCE.

JULY 1 TO 5

MUSEUMS ASSOCIATION (at Worthing).

Monday, July 1

Tuesday, July 2, at 10 A.M. (in Connaught Hall).—Sir Henry A. Miers Co-operation—the Association's Task (Presidential Address).—Reading and Discussion of Papers.

At 3 (in Connaught Hall).—Reading and Discussion of Papers.

Wednesday, July 3, at 10 A.M. (in Connaught Hall).—Reading and Discussion of Papers bearing on the Co-operation of Museums in this Country and throughout the Empire, and on the Work of the Association in this Connexion.

At 2 15 (in Connaught Hall).—Reading and Discussion of Papers.

Thursday, July 4, at 10 A M.—Reading and Discussion of Papers.

At 11 30 A.M —Annual Business Meeting.

Friday, July 5 —Excursions.